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**Spectral Response of Thermal Sensitization
Method of Photographic Recording in Medium
and Far Infrared Spectra**

917K0214A Moscow ZHURNAL NAUCHNOY I
PRIKLADNOY FOTOGRAFII I KINEMATOGRAFII
in Russian Vol 36 No 1, Jan-Feb 91 pp 30-34

[Article by V. A. Batanov, K. Yu. Kuzmin, I. A. Lesnov,
A. S. Lysenko, S. V. Timofeyev, V. B. Flerov, O. M.
Khlebnikov, Technological Physics Institute at the
USSR Academy of Sciences, Moscow]

UDC 778.344

[Abstract] The spectral response of the photographic thermosensitization technique is determined within a broad 20-200 μm range based on measurement data on spectral absorption characteristics of all photographic film layers, i.e., the emulsion, the base, and the anti-halation layer. Characteristic curves of the FT-101 film are plotted in the far infrared and submillimeter spectra by the recording and densitometry of focal laser radiation spots on 90 and 152 μm wavelengths using an ammonia laser. Transmission spectra and maximum sensitivity areas are determined. The results show that the thermal sensitization photography method is suitable for quality measurements of the spatial radiation distribution of submillimeter band lasers. The resulting transmission spectra of FT-101 film layers make it possible to estimate the spectral response of this technique. It is shown that in order to increase sensitivity in the far infrared and submillimeter (SMM) spectra, it is necessary to use

photographic emulsions with elevated absorptance. References 8: 6 Russian, 2 Western; figures 3.

All-Union Conference on Photoresists

917K0214B Moscow ZHURNAL NAUCHNOY I
PRIKLADNOY FOTOGRAFII I KINEMATOGRAFII
in Russian Vol 36 No 1, Jan-Feb 91 pp 89-90

[Article by Ye. N. Pribylova]

UDC 773.92 + 776.19

[Abstract] The First All-Union Conference on Photoresists organized by the Scientific Council of the USSR Academy of Sciences on the problem of "Photographic Data Recording Processes" together with the Interbranch Scientific Production Association (MNPO) "Scientific Research Institute of Organic Semiconductors and Dyes" (NIOPiK) and the Electrochemistry Institute at the USSR Academy of Sciences was held on 22-24 March 1990 in Zvenigorod. Over 200 representatives of 58 institutes and production associations from 25 cities of the union participated in the conference. Thirteen plenary reports and 78 poster presentations on the following subjects were made at the conference: the chemistry of polymerizing system, mechanisms of photochemical reactions, and various photosensitive systems; the synthesis and technology of photoresist production; the properties and applications of photoresists in microelectronics; lithographic processes; resist quality control methods and devices, etc. It was decided to hold the second photoresist conference in 1992.

Estimating Intensity of Optical Signal of Unknown Duration

917K0210A Kiev IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA
in Russian Vol 33 No 11, Nov 90 pp 7-11

[Article by A. P. Trifonov and T. M. Ovchinnikova]

UDC 621.391.63

[Abstract] An optical signal of unknown duration τ_0 but with a rectangular intensity profile is considered and its intensity β is estimated, assuming that over a time interval $[0, T]$ its mixture with a background noise of also unknown intensity α_0 appears as realization of a Poisson $\pi(t)$ process. Preliminary quasi-likely estimates of the two intensities, namely their magnitudes which maximize the logarithm of their likelihood functional over some expected length of the signal duration τ^* , are followed by maximum-likelihood estimates of both intensities made based on statistical simulation of a simple receiver which consists of a switch open over the observation time interval $[0, T]$, an integrator acting as pulse counter, a $T - \tau^*$ delay line, and two amplifiers with gains proportional to $1/\tau^*$ and $1/(T - \tau^*)$ respectively. Calculations made on a Standard System 1060 computer have yielded estimates, their dispersion approaching the theoretical one. Their accuracy is found to improve with use of a more sophisticated receiver, this improvement becoming more significant with increasing a posteriori accuracy of estimates and with increasing error $\tau^* - \tau_0$ of the expected signal duration. When that error, the signal-to-noise ratio β_0/α_0 , and the total number of observed noise spots $\alpha_0 T$ are small, however, then the both intensities may be more accurately estimated in the simple receiver. Figures 5; references 4.

Coherent Rank Processing of Narrow-Band Signal With Noise

917K0210B Kiev IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA
in Russian Vol 33 No 11, Nov 90 pp 25-30

[Article by S. Z. Kuzmin, S. S. Kostina, and I. S. Grintsuk]

UDC 621.396.96:621.391.26

[Abstract] Coherent rank processing of a narrow-band signal with a wideband Gaussian noise is evaluated for efficiency, considering a signal of known duration τ but unknown frequency f_s within a given range $[0, F]$. Its complex envelope is $S(t) = \sum_{m=0}^{M-1} S_m e^{-j2\varphi_s t + j\varphi_s \delta(t - mT - t_0)}$ over $m = 0, \dots, M-1$ (φ_s - random numbers representing phases uniformly distributed over the $[-\pi, \pi]$ interval, S_m - constant amplitudes, $T = 1/F$, t_0 - signal arrival time, $0 \leq t_0 \leq T$, $M = \tau/T$). The spectrum of the noise is assumed to be N times wider than that $[0, F]$ range of signal frequency. Coherence of the processing is ensured

by use of the discrete Fourier transform, the time discretization intervals $T = 1/F$ and $dt = T/N$ being selected for the signal and for both orthogonal components of the noise respectively. The discrete realization of the input process of given form is described by $M \times N$ -dimensional X^{cs} -matrices (superscripts s and c referring to in-phase and quadrature components respectively). Rank transformation is effected on the basis of two linear two-sample tests: sign test and Mann-Whitney test. Analysis based on simulation and 1000 statistical experiments confirms that, as according to theory, the values of the rank vector $[begin set] R\Phi_m^{cs} [end set]$ ($m = 0, \dots, M-1$) form a Gaussian distribution of random numbers in the absence of a signal and that appearance of a signal will suppress noise within the f_s frequency band. An increase of N without a change of N is shown to improve the processor output characteristics in terms of a higher (signal + noise)/noise ratio, while an increase of M without a change of N does not significantly increase that ratio. Figures 3; tables 2; references 3.

Program for Adequate Combined Circuit-Physical-Topological Modeling of Bipolar Large-Scale-Integration Fragments

917K0210C Kiev IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA
in Russian Vol 33 No 11, Nov 90 pp 51-55

[Article by A. N. Bubennikov and A. V. Chernyayev]

UDC 53.072:681.33:621.3.049.771.14

[Abstract] A program for computer-aided combined circuit-physical-topological modeling of bipolar large-scale-integration fragments has been written which includes algorithmic adaptation of numerical calculations. The known Ebers-Moll, Hummel-Poon, and other electrical models of transistor structures are not adequate for this purpose, being based on the one-dimensional approximation of static behavior so that they do not fully account for the effects of heavy injection and quasi-saturation on the dynamic behavior. This program, STRAN 2, consists of two parts: transient analysis using adequate physical-topological models and circuit design. The physical-topological models of a bipolar transistor structure are based on the fundamental system of semiconductor equations in the two-dimensional approximation which takes into account effects of heavy doping on the electrophysical properties, with appropriate initial and boundary conditions, this system being reduced to one of linear algebraic equations. For the circuit design part of the program these models are presented in the form of two current sources in a common-emitter configuration, both base current and collector current depending on the respective applied potentials and on certain "internal" model variables. The two parts of the program are interfaced by circuit variables: potentials and currents. Inasmuch as the models cannot be described in an analytical form,

ensuring stability and convergence of static-state and dynamic-state calculations necessitates inclusion of special adaptive algorithms involving identification of "critical" circuit nodes (where small change of potential causes large change of current in incident branches) for selection of the iteration parameters and of the time discretization interval respectively. The static-state calculations are made according to Newton's method. Circuit design calculations are made according to Euler's explicit scheme. The program is written for an Elektronika-82 minicomputer, a low-speed machine but one with a sufficiently large random-access disk memory. It is written in an input language similar to SPICE 2 but with a semantic extension for describing physical-topological models. It was tested, with three physical-topological models, on calculation of transients in a single-input ECL element with an emitter follower at the output. Figures 2; references 5.

Optimization of Parameter of Signal Space-Frequency Processing in Wideband Radar

917K0210D Kiev IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA
in Russian Vol 33 No 11, Nov 90 pp 67-68

[Article by A. A. Shcherbakov]

UDC 621.396.67

[Abstract] A wideband radar with two space channels is considered for space-frequency processing of signals, the problem being to optimize the bandwidth Δf of the partial frequency channel for minimum normalized sum $P_{i,n}$ of interference power and noise power at the compensator output. This is done, assuming that a useful signal enters only the main space channel and a wideband interference signal from a point source enters both channels but with the main channel receiving m times less of its power than the auxiliary one. When the compensator generates a weight vector in the auxiliary channel according to that criterion, then the sum of residual uncompensated interference power and noise power will be $P_{i,n+k} = P_i(1 - d^2(1 + k) + P_n(1 + m^{-1}(1 + k))$ (P_i - power of interference at entrance to main space channel, P_n - power of intrinsic noise at entrance to each space channel, $d = (\sin(\pi B)/\pi B)$, $B = \Delta f \tau$, τ - delay time of interference signal propagating through aperture of receiver antenna, k - numerical factor representing effect of noise in control loop). The lower bound for k is $\mu/4\tau_0\Delta f$, μ - transmission coefficient referring to trim circuit, $\tau_0 = (1 + \mu)/2\pi\Delta f_k$ - time constant of low-pass filter in trim circuit, Δf_k - equivalent bandwidth of closed control loop. On this basis is evaluated the dependence of the ratio $X = P_{i,n}/P_{i,n+k}$ on the bandwidth Δf . This ratio is found to have a maximum at a certain bandwidth, its maximum increasing and shifting to smaller bandwidth as $q_{i,n}$ increases. Figures 1; references 2.

Effect of Correlation Between Components of Echo Signal From Target on Elevation-Angle Errors

917K0210E Kiev IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA
in Russian Vol 33 No 11, Nov 90 pp 68-70

[Article by A. V. Mikhaylov and V. L. Rumyantsev]

UDC 621.396.96

[Abstract] Measuring the elevation angle of a target above a surface is considered, in which case the echo signal at the radar receiver consist of two out-of-phase components reflected by the target and by that surface respectively. A correct statistical analysis of the angle noise in such a measurement requires that the correlation between these two components be taken into account and therefore the dependence of the elevation-angle error on their cross-correlation coefficient be evaluated. This is done on the basis of the two-point model of a target and a radar receiver in the same elevation plane. The surface of the target is represented as m groups of reflectors which have no dominant stable brilliant spots and combine to form a signal with a Rayleigh distribution of amplitudes. Reflection of a signal from the radar transmitter by the ground surface back to the radar receiver is assumed to be negligible and reflection of an echo signal from the target by that surface is assumed to be diffuse, which corresponds to a Nakagami probability density distribution of the amplitudes of both signal components with parameters m_i and Ω_i ($i = 1, 2$). On this basis are derived relations for the probability density distribution $W(v)$ of the relative elevation-angle error v and the probability $P(v \geq 1)$ of that error being equal to or larger than 1. Both have been calculated accordingly on a digital computer, not only the values of the correlation coefficient R being varied but also the values of the two parameters $m_1 = m_2 = m \geq 0.5$ and $h_0 = \Omega_2/\Omega_1$ of the two-dimensional Nakagami distribution. Figures 2; references 4.

Fiber-Optic Transmission Liners for Antennas

917K0210F Kiev IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA
in Russian Vol 33 No 11, Nov 90 pp 77-79

[Article by A. V. Sidorenko and V. S. Kurilo]

UDC 681.7.068

[Abstract] Use of fiber-optic transmission lines with an injection laser in measurement and control channels of phased antenna arrays is proposed for processing microwave signals with direct amplitude modulation of the laser radiation, "pulse" transmission being preferred so that conventional double-heterojunction semiconductor lasers may be used. Considering the stringency of requirements with regard to signal energy, signal-to-noise ratio, and phase characteristics, an experimental

study was made involving three such transmission lines: 1) single channel, 2) two channels, 3) two channels with optical channel switching. A semiconductor avalanche photodiode inside a cylindrical resonator cavity, followed by a parametric amplifier if necessary, is recommended as demodulator of the optical carrier on the output side of the transmission line. For a two-channel transmission line the microwave oscillator is fed to the laser through a microwave power divider, this divider being replaced with an optical switch for operation of the antenna in the monitoring mode. Testing was done with a source of continuous centimetric-wave signals, a calibrated attenuator, a both low-pass and high-pass filter as demultiplexer placed behind the photodetector for "pulsed" operation and followed by a phase detector which also received the output signal of a microwave phase shifter, a clock pulse generator, a digital-to-analog converter electrically controlling the phase shifter and controlled by a counter of clock pulses, and an amplifier of the phase detector output signal. That signal, upon amplification, was fed to a sample-and-store device which in turn fed a signal to a control circuit and to a comparator, the latter being triggered when the phase difference between the two detector input signals was $+90^\circ$ or -90° . Two optical switches were tried, the $K_0 = PKh1x202$ optomechanical and an experimental optoelectromechanical one. The standard deviation of phase fluctuations did not exceed 3° , the phase difference between channels was $10-11^\circ$ with the optomechanical switch and $5-6^\circ$ with the opto-electromechanical one. Figures 3; references 4.

Experimental Investigation of Spectral Characteristics of Coherent Signals Reflected From Vegetation in Shorter Wave Range of Millimeter Band

917K0177A Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 33 No 8, Aug 90 pp 895-901

[Article by V. S. Korostelev, G. I. Khlopov, V. P. Shestopalov, Radiophysics and Electronics Institute at the Ukrainian Academy of Sciences]

UDC 621.371.3.029.65

[Abstract] The results of an experimental investigation of Doppler spectra of 2 mm band echo signals from grass, bushes, single trees, and forest edge along near-earth paths are cited. A coherent instrumentation radar (RLS) was used in measurements; its operation is based on a diffraction radiation generator whose parameters make it possible considerably to lower the noise factor of the locator receiver in the Doppler frequency band compared to other types of generators. It is shown that the principal echo signal energy is concentrated in the frequency range under 100 Hz. It is noted that compared to longer wave bands, the echo signal spectrum shape is characterized by a greater rectangularity; during wind gusts, a pedestal appears in the spectrum at the $-(30-40)$

dB level which is probably due to an amplitude modulation of the echo signal spectrum by moving leaves; the spectrum width largely depends on the wind bearing relative to the path; and the principal contribution to the coherent echo signal spectrum in the shorter wave range of the millimeter band (KVCh MMD) is made phenomena related to the Doppler frequency modulation. References 11: 10 Russian, 1 Western; figures 4; tables 2.

Propagation of Slow MHD Variations Generated by Pulsed Acoustic Source Along Earth's Surface

917K0177B Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 33 No 8, Aug 90 pp 902-911

[Article by N. D. Borisov, B. S. Moiseyev]

UDC 550.388.2

[Abstract] The transformation of a sonic impact impulse into an electromagnetic perturbation is considered allowing for the geomagnetic field slope. The resulting perturbation represents a superposition of a quasistatic field and a moving perturbation. It is shown that in a sloping magnetic field the propagation velocity and field amplitude depend of the field azimuth. The law of field variation with distance is found and the velocity and amplitude are estimated numerically. It is demonstrated that localized MHD perturbation impulses propagating in the horizontal plane at speeds considerably lower than Alfvén's velocity develop over the earthquake epicenter. Its amplitude and velocity depend on the field azimuth and the angle of inclination. Closer to the equator, magnetic disturbance increases in magnitude given the same acoustic impulse. References 10: 7 Russian, 3 Western.

On Polarization Modification of Plane Electromagnetic Wave Reflected From Smooth Collisionless Plasma Layer

917K0177C Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 33 No 8, Aug 90 pp 912-918

[Article by N. S. Bukhman, Voronezh Forestry Engineering Institute]

UDC 533.951

[Abstract] Propagation of a plane monochromatic electromagnetic wave (EMV) in a collisionless plasma with known dielectric constant and incidence angle is considered. The polarization structure of EMV reflected by a smooth collisionless plasma layer is examined in the case where the incident wave is neither purely S - or P -polarized in the absence of data on the reflected P -wave phase. In so doing, quasiclassical asymptotics of a plane wave reflected by such smooth layer are considered. The

plane wave depolarization as well as the spatial separation of the wave beam into linearly polarized components during the reflection from the layer are discussed. It is shown that given a plasma resonance parameter similar to unity, the shift between the *S*- and *P*-components may amount to many wavelengths and become comparable to the initial beam width in the constriction. The author is grateful to A. L. Gutman and A. S. Sakharov for their interest in the work and stimulating comments. References 8; tables 2.

Electromagnetic Wave Scattering by Artificial Anisotropic Layers of Various Materials

917K0177D Gorkiy IZVESTIYA VYSSHIKH
UCHEBNYKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 8, Aug 90 pp 943-953

[Article by I. V. Borovskiy, O. G. Gamulya, N. A. Khizhnyak, Radio Astronomy Institute at the Ukrainian Academy of Sciences]

UDC 537.874.4.01

[Abstract] The solution of the problem of scattering by an infinite artificial anisotropic layer formed by frequent periodically recurring cells each consisting of two close-packed rectangular bars is derived and analyzed. The bars are made from a ferrite material, a dielectric material, or a metal. For a ferrite layer, a solution algorithm is synthesized and a description of scattered fields is obtained for all possible modes in the framework of a single solution method. The resulting expressions are examined numerically and analytically. It is shown that by selecting the dielectric constant and magnetic permeability in a certain way one can derive expressions for fields scattered by lattices made of dielectric, metal, and ferrite materials and their combinations. It is also shown that by selecting material and geometric parameters of the layer one can modify its reflecting properties within a sufficiently broad range. References 7: 5 Russian, 2 Western; figures 4.

Diffraction of Electromagnetic Waves by Thin Metal Strip Arbitrarily Oriented Relative to Plane Boundary Between Two Magnetodielectric Media

917K0216A Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR: SERIYA A—FIZIKO-MATEMATICHESKIYE I TEKHNIЧЕСKIYE NAUKI in Russian No 12, Dec 90 pp 38-42

[Article by S. N. Vorobyev and D. L. Litvinenko, Institute of Radio Astronomy, UkSSR Academy of Sciences, Kharkov]

UDC 537.874

[Abstract] The problem of diffraction of electromagnetic waves by a metal strip in a medium with a dielectric permittivity ϵ_1 a magnetic permeability μ_1 is solved for a thin metal strip in such a medium oriented at an arbitrary angle to the plane boundary between this medium and another one with a dielectric permittivity ϵ_2 and a magnetic permeability μ_2 , assuming that the strip is an ideal electrical conductor and the two media occupy a half-space each. The problem is solved rigorously by the spectral method and analytic inversion of the static part of the diffraction operator, considering that Green's function for both half-spaces satisfies the wave equation with the delta-function $-\delta(r-r_0)$ (r_0 —radius vector of source) as the right-hand side and either Neumann boundary conditions for H-polarized waves or Dirichlet boundary conditions for E-polarized ones. A convolution-integral equation is obtained for calculating the scattered field in a three-dimensional Cartesian system of coordinates with the origin at the center of the strip, this equation being reduced to an equivalent pair of integral equations. These are reduced to a system of linear algebraic equations of the second kind with a Fredholm matrix operator and thus readily solvable numerically by the method of elimination. Figures 1; references 8.

Exact Solutions to Problem of Metal Fusion and Vaporization by High-Intensity Energy Flux

917K0216B Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR: SERIYA A—FIZIKO-MATEMATICHESKIYE I TEKHNIЧЕСKIYE NAUKI in Russian No 12, Dec 90 pp 46-48

[Article by R. M. Cherniga and I. G. Odnorozhenko, Institute of Engineering Thermophysics, UkSSR Academy of Sciences, Kiev]

UDC 517.9:535.21

[Abstract] The boundary-value problem of metal fusion and vaporization by a high-intensity energy flux, during

the quasi-steady stage after the transient period, is formulated in the one-dimensional approximation in a system of coordinates with the origin at the center of the evaporation front and moving with it. Exact solutions to the problem are shown for three different temperature characteristics of the thermal conductivity $\lambda_k(T_k)$, the specific heat $c_k(T_k)$, and the density $\rho_k(T_k)$ ($k=S$ or L , S —solid, L —liquid): 1) λ , c , and ρ arbitrary differentiable functions of T , but $\lambda/cp = \kappa = \text{constant}$; 2) $\lambda = \alpha + \beta T$ and $cp = \gamma$ (α, β, γ in R^1 -space); 3) $\lambda = \alpha = \text{constant}$ and $cp = \gamma + \delta T$ (α, γ, δ in R^1 -space). These exact solutions are compared with numerical solutions for aluminum at 500 K temperature initially and a heating power of 1 MW/cm². Figures 1; references 4.

Measuring Angular Coordinates of Object With Signals Subject to Tropospheric Distortions

917K0206A Moscow RADIOTEKHNIKA in Russian No 11, Nov 90 pp 3-6

[Article by V. N. Privalov]

UDC 621.391

[Abstract] Measuring the angular coordinates of an object with signals subject to distortions in a locally homogeneous troposphere is examined for adequacy of data processing algorithms based on the assumption of Gaussian phase distortions and modulating interference. An evaluation is made by the method of statistical simulation, considering the plane which passes through both a point target B and an equidistant linear antenna array of N receiver elements along the OX axis so that the total length of the observation zone is $L = \Delta x(N-1)$. At given points in this plane is assumed to appear an additive mixture of a useful signal distorted by a modulating interference and a white Gaussian noise. The maximum likelihood ratio is selected as criterion for optimum processing of this mixture. Direct application of the algorithms is shown to lead to infinitely large elements of the correlation matrix. This can be avoided by replacing the locally homogeneous model with the homogeneous one, using for this the appropriate structural approximating function. The results of statistical analysis indicate that the effectiveness of those algorithms weakens when phase distortions or modulating interference deviate from Gaussian ones, unless the signal-to-noise ratio is very high. The choice of resolving function for estimation of an angular coordinate, which requires locating the principal maximum of that function, and the choice of algorithm for calculating the dispersion of an estimate will both depend on the relative size of the observation zone and on the parameters of the locally homogeneous model, this model being usually based on the assumption of an isotropic turbulence. Figures 3; references 5.

Mellin's Indeterminacy Function

91TK0206B Moscow *RADIOTEKHNIKA in Russian*
No. 11, Nov. 90, pp. 6-8

[Article by V. A. Saprykin and S. I. Tynyankin]

UDC 621.396

[Abstract] Several key properties of Mellin's indeterminacy function $\chi(\alpha, \omega)$ for analyzing the properties of signals are described, considering that nonstationary algorithms of signal analysis and synthesis based on the Mellin transform are eminently suitable when relative motion of the transmitter and the receiver characterized by their radial velocities and acceleration (Doppler effect) needs to be taken into account. This function is derived from the complex envelope of a Mellin signal $S(t^{1/\alpha} \cdot e^{j\omega t})$ with a $1/(t \log t)$ spectrum. Its largest value is $\chi(\alpha, \omega) = \chi(1, 0)$, by virtue of the Cauchy-Schwarz inequality. The volume V , namely the double integral of $\chi(\alpha, \omega) d\omega d(\log \alpha)$ with both ω and $\log \alpha$ from $-\infty$ to $+\infty$, is equal to $\chi(1, 0)$ and thus constant. It follows from this property that the potential interference immunity of signal processing in the velocity-acceleration plane is the same for all signals carrying equal amounts of energy, also that any change in the signal parameters causing a compression or expansion along the ω -velocity axis will also cause correspondingly an expansion or compression along the α -acceleration axis. As far as the respective resolutions are concerned, therefore, improvement of either one will be accompanied by worsening of the other. References 9.

Generating Quasi-Coherent Phase-Shift-Keyed Compound Multifrequency Signals With Surface-Acoustic-Wave Devices

91TK0206C Moscow *RADIOTEKHNIKA in Russian*
No. 11, Nov. 90, pp. 10-14

[Article by N. I. Smirnov, I. V. Sizov, and A. R. Petrov]

UDC 621.396.6

[Abstract] Use of surface-acoustic-wave (SAW) frequency synthesizers instead of direct-type analog or digital ones in generators of binary phase-shift-keyed (BPSK) compound multifrequency signals for asynchronous data transmission with frequency skip but no phase discontinuity during the period of a useful pulse is considered, which will extend the frequency range of quasi-coherent or ideally coherent synthesizer output oscillations from tens of megahertz attainable with digital synthesizers to hundreds of megahertz without the intricate circuitry of analog ones. Built with standard microelectronic components so as to ensure high manufacturing precision and reproducibility, SAW devices offer the advantages of small size and weight as well as low power requirement and high reliability. A frequency synthesizer with SAW devices includes also a master oscillator which generates harmonic signals of frequency $f = 1/T_c$ (T_c - duration of elementary pulse, in the nanosecond range) used for synchronizing the generator of

short pulses and the generator of recurrent sequences. The master oscillator consists of two shift registers with feedbacks and an adder connected into an equivalence circuit. The generator of short pulses consists of a T_{SM}/T_c frequency divider and a differentiating circuit, which form sequences of pulses with a repetition period equal to the period of one frequency segment T_{SM} . These pulses pass successively through an open switch, in accordance with the quaternary E-sequence code, to the inputs of programmable delay lines formed by interdigital transducers and excite the latter into forming segments of compound signals with a different frequency but the same initial phase each. High interference immunity of asynchronous data transmission is achieved by transmission of two compound signals in phase opposition, using for instance a basic recurrent sequence and a negative one formed respectively by two interdigital transducers in phase opposition on the input side of each delay line. A theoretical performance analysis and numerical estimates indicate a not larger than 1.3 dB energy loss due to manufacturing imprecision and destabilizing external effects under optimum conditions and thus the feasibility of generating BPSK compound signals with frequency skips but no phase discontinuity at carrier frequencies up to 300 MHz. Figures 4; references 8.

Discrete Wideband Microwave Attenuators

91TK0206D Moscow *RADIOTEKHNIKA in Russian*
No. 11, Nov. 90, pp. 24-26

[Article by A. R. Tagilayev]

UDC 621.372.852.3.08

[Abstract] A prototype of a discrete wideband microwave attenuator with a symmetric slot-line ring between two asymmetric strip-line structures, the ring containing a fixed absorber, was built and tested for design and performance evaluation. The ring consists of two parallel switching channels, each a four-pole two-port network of semiconductor-diode switches, between two coupling circuits which establish the topological constraints on the vectors of incident and reflected waves. Each coupling circuit is a six-pole three-port twin-T network, with two ports closing the ring and the third port to a matching circuit. The two matching circuits are four-pole two-port networks connecting the ring to the attenuator input and output terminals respectively. Each matching circuit contains two quarter-wave asymmetric strip lines in cascade, one shorted and one open, with a transformer coupling to the symmetric slot line. The prototype was designed for a 5 GHz nominal operating frequency, with the symmetric slot-line ring and the circle stripped of metal coating 14.5 mm and 8 mm in diameter respectively. The wave impedance of each shorted asymmetric strip-line loop connected to the symmetric slot-line ring is 85 Ω , that of the remaining asymmetric strip-line segments being 50 Ω and that of the symmetric slot-line ring being 65 Ω . The switches p-n diodes operating with a 15 mA control current. The fixed absorber is a 4 dB PR1-1. Measurements of internal and insertion losses have yielded nearly flat frequency characteristics of both over the 2-6 GHz

range, both losses being consistently larger than calculated. The insertion loss, moreover, was smaller than in an attenuator built with chip resistors forming a Π network of 95.3 Ω parallel resistors and 71.5 Ω series resistors. Figures 3; references 1.

Energy Characteristics of Signal Reflected by Randomly Uneven Surface

917K0206E Moscow *RADIOTEKHNIKA in Russian*
No 11, Nov 90 pp 32-35

[Article by V. D. Bukharin, B. I. Orekhov, A. A. Gar-nakeryan, and V. B. Skorik]

UDC 621.396.969

[Abstract] Two analytical expressions are derived for the power of a short-wave radar echo pulse signal returning to an aircraft after reflection by a rough sea surface. They describe the average power of an echo pulse and the average power of its fluctuations respectively, both averaged over respective envelopes, as functions of time. The surface is assumed to be continuous and flat with a finite dielectric permittivity, its roughness to be two-dimensional in Cartesian coordinates (x,y), and is treated as a uniform normal random field of asperity height h fluctuations with zero mean, dispersion σ^2 , and correlation function $\rho(\Delta x, \Delta y)$ so as to make it permissible to use Kirchhoff's method for calculating the reflected field. On this basis, the maximum average power of the echo pulse is shown to depend on the height of surface asperities and on the flight altitude but neither on the duration of the incident sounding pulse nor on the sloping angle of surface asperities. The waveform of the envelope of average echo signal power, moreover, duplicates the waveform of the sounding pulse. The average power of echo pulse fluctuations is shown to increase with increasing height of surface asperities and to decrease with increasing flight altitude as well as with closer correlation between asperity sloping angles in the orthogonal x,y directions. The waveform of the envelope of average fluctuation power, however, differs from the waveform of a finite-duration sounding pulse. Numerical calculations were made for 600 m, 2000 m, 6000 m flight altitudes above the sea surface sounded by 1 μ s pulses of 10-100 m long electromagnetic waves. Figures 2; references 3.

Distance Measurement With Digital Radio Signal Receivers

917K0206F Moscow *RADIOTEKHNIKA in Russian*
No 11, Nov 90 pp 36-40

[Article by A. N. Bondarev, M. I. Zhodzishskiy, and S. Yu. Sila-Novitskiy]

UDC 621.396.62

[Abstract] Measurement of distance D by the pseudonoise method of tracking the delay time $t_1 = D/v$ (v-velocity of radio wave propagation) is analyzed, in this method pseudorandom sequences being generated by an m-bit shift register with appropriately matched feed-backs so that $M = 2^m - 1$ sequence elements of duration τ occur within one signal period T. Only once during a signal period do m identical "1" elements appear in succession and is thus formed the longest pulse, of duration $m\tau$. The word boundary, beginning of this pulse, coincides with the instant of time when all register elements are in the "1" state. Word boundaries in the transmitted signal thus coincide with specific markers on the fixed transmitter time scale in the interrogative mode or on the adjustable airborne time scale in the noninterrogative mode. Setting up both time scales involves a digital filter, a discriminator, and a clock frequency synthesizer such as a storage adder which generates a control code with a constant summation frequency f_0 . Its overflow pulses serve as pulses of clock frequency f_c for the register, this frequency being adjustable by the delay tracking system and much lower than f_0 when phase fluctuations with attendant energy losses need to be minimized but not when phase fluctuations can be useful in reducing discretization errors. There is also a fixed nominal frequency generated in this system. For determining the delay time, one needs only to subtract the lagging code of the fixed time scale from the leading code of the adjustable time scale. Discrete frequency control of the synthesizer is preferable to discrete phase control, because then measurements can be made no matter how wide the range of Doppler frequency shifts becomes. A receiver is considered which contains the tracking system, the synthesizer with either discrete frequency or discrete phase control, and a frequency divider. A reliability analysis of such a receiver indicates that a short intermittent fault in the synthesizer will give rise to transients in the delay tracking system, but the latter will afterwards return to normal operation, while an intermittent fault during programmed delay time measurement with discrete frequency control will give rise to an estimation error carried through all following clock cycles. The discretization error in this pseudonoise method of measuring time delay is, meanwhile, much smaller than in conventional measurement by standard-frequency pulse count. Figures 5; references 8.

Multiposition Signal Detectors With Compensation of Normal Interference

917K0206G Moscow *RADIOTEKHNIKA in Russian*
No 11, Nov 90 pp 40-43]

[Article by I. A. Golyanitskiy]

UDC 621.396.96.001(07)

[Abstract] Optimum simultaneous multiposition detection of signals is considered which combines matched linear filtration with compensation of interference.

Interference $y_j = y(t_j)$ ($j = 1, 2, \dots$) and interference $z_i = z(t_i)$ ($i = 1, 2, \dots$) are each assumed to be strongly correlated and to have a normal probability distribution. They are represented by the resultant vector $Y_1 = (Y, Z)$ of sampled readings $Y = (y_1, y_2, \dots)$ and $Z = (z_1, z_2, \dots)$. Also a passive interference represented by vector $X_1 = (X, X)$ is assumed to appear at the detector input together with a signal represented by vector $S_1 = (S, S)$. The detection algorithm involves calculating the logarithm of the ratio conditional likelihood functions $\log[f(Y_s, Z_s/X_1)/f(Y, Z/X_1)] = \log[f(Y_s/X)/f(Y/X)] + \log[\inf_s/Y_s, X)/f(Z/Y, X)]$ involving two partitioned correlation submatrices. The optimum detector consists of a compensator which takes into account autocorrelations of interference vectors Y, Z and cross-correlations of interference vectors $(Y, Z), (Z, X)$, two weighting matrix filters, and a bank of matched filters. Dichotomy of the $Y_1 = (Y, Z)$ vector and reducing the dimensionality of those two submatrices may simplify the calculations and prove to be preferable, on account of better machine time economy, for detection by a special computer or by programming a microcomputer. Figures 2; references 2.

Digital Method of Delaying Signals

917JK0206H Moscow RADIOTEKHNIKA in Russian
No 11, Nov 90 pp 43-45

[Article by V. N. Taran and K. A. Chasnik]

UDC 53.089.5.089:53.087.92.088

[Abstract] A digital method of delaying signals with the possibility of regulating time intervals not multiples of the pulse repetition period is proposed, its precision depending on the degree of the interpolation polynomial $P_n(t)$ for a signal $s(t)$ and on the degree of smoothness of the analytical expression which describes that signal. The problem of delaying a signal $s(t)$ by a time $\tau < \Delta t_i = t_i - t_{i-1}$ reduces to finding the values of that polynomial $P_n(t_k + \tau) = s_j$ ($j = 0, \dots, N$) when the magnitudes of that signal $s_k = s(t_k)$ at discrete instants of time t_k on the interval $[0, T]$ ($k = 0, \dots, N$) are known. Selecting a low-degree interpolation polynomial and splines is preferred to selecting a high-degree polynomial and then solving an unwieldy system of linear equations with attendant error accumulation. An example is use of normalized parabolic B-splines in the case of a uniform time discretization interval $\Delta t_i = \Delta t$ ($i = 0, \dots, N$). For linear interpolation with a first-degree polynomial is considered a delay unit consisting of an analog-to-digital converter, two multipliers, a delay element, a code inverter, and an adder. The error of restoration of the original signal at some instant of time $t_j = t_i + \tau$ is then calculated, assuming that readings of the signal have been taken at instants of time sufficiently close to satisfy Kotelnikov's theorem. This digital method of delaying signals is shown to be universal and to allow regulating the delay time, which is not possible in conventional methods, most effectively delays shorter than the shortest pulse repetition period. The method

does not require analytical description of the signal and is applicable with any interpolation mode. Figures 2; references 5.

Invariant Noncoherent Single-Sample Detection of Signal in Unknown Position Submerged in Gaussian Background Interference of Unknown Intensity

917K0206I Moscow RADIOTEKHNIKA in Russian
No 11, Nov 90 pp 45-47

[Article by G. M. Bashin]

UDC 621.396-96

[Abstract] Optimal noncoherent single-sample detection of an additive mixture of a random signal and nonfluctuating one in unknown positions in a sample is considered, the sample having a multidimensional probability density in a multichannel system with a stationary Gaussian interference of unknown power. The maximum-likelihood decision rules are established for detection of each signal which will ensure a certain constant false-alarm probability and be invariant with respect to the unknown scale parameter, namely the interference energy parameter. An analysis reveals that the efficiency of detection on the basis of these decision rules fast approaches the efficiency of optimum Neumann-Pearson rules as the sample volume is increased and the unknown interference energy parameter thus better estimated. This is demonstrated by the results of numerical calculations based on a $D = 0.95$ detection probability and a $F = 0.01$ false-alarm probability, the relative efficiency loss due to the a priori indeterminacy of the two signals in this case not exceeding 2.5 dB and 1.8 dB respectively. Figures 1; references 4.

Immunity of Reception of Discrete Messages to Atmospheric Radio Interference

917K0206J Moscow RADIOTEKHNIKA No 11, Nov 90
pp 48-49

[Annotation of article by V. V. Kabanov, article No 1676-sv deposited at Central Institute of Scientific and Technical Information 'Informsvyaz']

UDC 621.396.62

[Abstract] Reception of a known weak binary signal in the presence of nongaussian atmospheric background interference is analyzed for immunity to this interference when the receiver has been appropriately optimized and includes a blanking device for interference suppression (A.D. Spaulding and D. Middleton, IEEE Trans. Vol COM-25 No 9, 1977). The relevant component of the error probability is calculated as a function of the ratio of signal power to residual interference power, considering a Poisson-Poisson distribution of interference pulses. The trend of that function depends principally not only on the range β_1 over which the amplitude

of pulses within their amplitude probability distribution varies and on the maximum pulse overlap factor A , of the low-frequency equivalent of the filter array. An analysis of this relation and numerical calculations for Q from 1 to 20 reveal that such a receiver may fail when Q is high as required for high selectivity and β_1 is wide as in the case of nearby storm activity. It therefore becomes necessary to narrow the range of pulse amplitude variation β_1 so that the necessary number of independent readings N can be obtained. This is achieved by inserting, in addition to the blanking device, another pulse interference suppressor before the filter of the master frequency selector according to the known "wide-limiter-narrow" scheme. The minimum attainable β_1 is determined by the ensemble of signals from neighboring radio stations as well as by Q , A_{LM} , and N . Figures 1; references 3.

Bulgarian Computer Manufacturing Firm ZIT in Sofia

917K0206K Moscow *RADIOTEKHNIKA in Russian*
No 11, Nov 90 p 51

[Advertisement]

[Abstract] ZIT, the largest computer manufacturing firm in Bulgaria, employs highly qualified specialists in this field as well as the newest technologies developed by JORDAN, HOLLIS, SVECIA, OLIVETTI, and other firms. Accordingly, ZIT is ready to supply its customers with the complete universal YeS 1037 computer and with 1037-based high-productivity IZOT 1703Ye complexes including YeS 2706, YeS 2706M, YeS 2709, and YeS 2710 processors for giant research projects. The firm produces computer systems based on the YeS 8371M teleprocessor for long-distance data exchange. It is a major producer and supplier of 200/317/635 MB modules and disk subsystems in East Europe. It has developed a new ZIT 5800 380 Mbyte memory on the basis of Winchester-type disks which combines much higher reliability, much lower energy consumption, smaller mass, and fewer rotations without any reduction of functional capabilities. Its product line includes SM 1426 minicomputers, efforts being made to raise the capacity of their disk subsystem to 1.2 Gbyte, and also 32-bit personal computers. Furthermore, ZIT offers accessories needed for expansion of already purchased systems and the YeS 2137 processor as a more reliable and more compact replacement for existing YeS central processing units.

Coherent-Light Fiber Optics for Data Transmission, Processing, and Storage

917K0206L Moscow *RADIOTEKHNIKA in Russian*
No 11, Nov 90 pp 69-79

[Article by N. N. Yevtikhiyev and D. I. Mirovitskiy]

UDC 621.391.029.7

[Abstract] Progress made in development of coherent-light fiber optics since 1984 is reviewed, up to the

present status of scientific and technical research in this area. First are considered fiber-optic data transmission systems, likely to become the principal data transmission systems capable of operating at high speeds up to 100 Gbit/s. Four functionally different types of such systems can be identified here: 1) fiber-optic lines for station-to-station data exchange, 2) fiber-optic systems for automatic control of industrial processes and vehicular traffic, 3) fiber-optic systems for multiple-access local computer networks, 4) fiber-optic systems for public and private communication services. Noteworthy practical achievements in fiber-optic long-distance communication are the TAT 8 Transatlantic Telecommunications line (United States - Great Britain - France) and the HAW-4/TRC-3 Transpacific Telecommunications line (Point Arena/California - Makaha Beach/Oahu - Taniguisson Point/Guam - Sikura/Japan). Outstanding contributions to theory and design of fiber-optic data transmission systems have been made by the Moscow Institute of Radio Engineering, Electronics, and Automation. The parabolic transmission-line equation has been recently solved for a single-mode optical fiber with anomalous dispersion and nonlinear phase modulation (A.A. Balagur, *RADIOTEKHNIKA* No 10, Oct 90). A method of solving the inverse problem of backscattering and estimating the pulse self-compression has been recently proposed which is workable regardless of how the refractive index depends on the amplitude of the electromagnetic field. Next are considered fiber-optic and integrated-optics data processing and storage systems, principally for analog and digital computer-related apparatus such as convolvers, correlators, spectrum analyzers, pattern recognizers, analog-to-digital and digital-to-analog converters, bistable memories, logic elements, and above all joint/branch circuits such as the Fox-Mueller junction. Here too the Moscow Institute of Radio Engineering, Electronics, and Automation has made outstanding contributions, its scientists having in 1959 discovered cophasal local coupling of slow SHF and optical-frequency electromagnetic waves at intersections of round or rectangular waveguides. Noteworthy are asymmetric junctions with local coupling and symmetric 2-channel Y, T, and X junctions, also multi-channel Ψ and other junctions used in multipole devices such as multiplexers, demultiplexers, Mach-Zehnder interferometers, modulators, switches, and various other devices. An interesting development is a high-sensitivity detector of gravitational waves (V.K. Sakharov, *RADIOTEKHNIKA*, No 11, Nov 90). On the basis of a fiber-optic Mach-Zehnder interferometer, in turn, have been developed many analog-to-digital and digital-to-analog converters for computers, noteworthy being the 8-bit A/D converter with a holographic coder on an electrooptic substrate. The newest category of coherent-light optical systems covered in this review are data collection systems, namely fiber-optic and integrated-optics transducers of physical quantities. Many of them are of the amplitude-modulation type, their principle of operation being intensity modulation of the transmitted laser radiation by the measured physical quantity. Some of them are of the phase-modulation type, more sensitive

but also more complex, which include differential interferometric and polarimetric transducers of the phase-modulation type using special optical fibers: single-mode fibers with polarization stability or two-mode fibers. While not more sensitive than conventional transducers, these optical ones have a higher interference immunity and a wider operating temperature range combined with higher thermal and chemical stability, making them irreplaceable in hazardous environments of any kind. Most promising are distributed data collection systems, unique systems based on the principle of a laser ranger, which provide a continuous distribution of the monitored physical parameter over a given area or volume. Such systems for temperature measurement have already been tested over the $-200-(+100)^{\circ}\text{C}$ range covering distances of up to 200 m, and found to be accurate within 1°C with a spatial resolution of about 3 m. Figures 9; references 69.

Optical Image Processing Using Periodic Structures

917K0209A Novosibirsk AVTOMETRIYA in Russian
No 5, Sep-Oct 90 pp 3-16

[Article by A. A. Lapides, V. E. Melamud, Moscow]

UDC 535.317.1

[Abstract] Methods of modulating the optical wave phase with the help of optical transparencies on the basis of diffraction gratings, methods of image encoding with the help of diffraction gratings, methods of spectral signals analysis by representing them in the form of periodic structures, and various methods of suppressing periodic interference in the image are reviewed. The physical essence of the detour phase. The results of using these methods in Gilbert-optics and theta-modulation tasks are presented. It is shown that the use of diffraction grating-based phase filters makes it possible to expand functional capabilities of the methods of simplify their implementation. It is also shown that modulation with the help of periodic structures makes it possible to expand functional capabilities of coherent optical processing methods and simplify their realization as well as more fully utilize the advantages determined by the two-dimensional character of images. References 101: 54 Russian, 57 Western Figures 5.

Thirty-Two Dot Analog Convolver Using Charge-Coupled Devices

917K0209B Novosibirsk AVTOMETRIYA in Russian
No 5, Sep-Oct 90 pp 36-42

[Article by I. E. Vornovitskiy, A. I. Kozlov, Kh. I. Klyaus, Ye. I. Cherepov, Moscow and Novosibirsk]

UDC 621.3.049.771.12:621.396.96 (088.8)

[Abstract] A simple linear unidimensional analog charge-coupled device (PZS) convolver is considered

and the principle of using it for developing an economical continuous image processing system (including variable-format images) is proposed. The possibility of processing images is determined by the regularity of the two-dimensional convolution. The digital-analog device performs both binary-analog and analog convolution and is capable of performing addition, subtraction, multiplication, and image signal convolution operations and can function as a programmable delay-time line. The device operates at clock frequencies of up to 3 MHz. Experimental convolver characteristics in the binary-analog mode are determined. The device's equivalent output is on the order of 10^9 single-digit binary addition-multiplication operations per second and makes it possible to use it for real-time signal and image processing. References 13: 9 Russian, 4 Western; figures 6.

Algebraic Justification for Selecting Gas Lasers for Detection and Ranging Instrument Systems

917K0209C Novosibirsk AVTOMETRIYA in Russian
No 5, Sep-Oct 90 pp 57-63

[Article by S. Alisherov, A. V. Ushakov, Leningrad]

UDC 621.396.967.029.7 (024):621.37

[Abstract] A procedure of algebraic justification for the selection of gas lasers (GL) for detection and ranging instruments systems is proposed on the basis of matrix invariants and noninvariants. To this end, the time and spatial stability of the CW gas laser radiation beam pattern axis (ODN) is analyzed with respect to the GL power, wavelength, divergence, and lasing mode structure. An algebraic GL model is derived. It is shown that the use of the algebraic GL model in the form of a transformation matrix of laser resonator beams makes it possible to perform a comparative analysis of competing GL's by purely algebraic means and select a laser which potentially is the least susceptible to the resonator element misalignment as well as estimate possible versions of the output beam vector as a function of this misalignment. References 12: 11 Russian, 1 Western; figures 8; table 1.

On Realizing Relaxation Method of Circuitry Engineering Analysis of MIS LSI Circuits on YeS Computer

917K0209D Novosibirsk AVTOMETRIYA in Russian
No 5, Sep-Oct 90 pp 80-86

[Article by V. V. Yefimenko, A. S. Zagoruyko, Yu. A. Stukalin, Novosibirsk]

UDC 621.372.011.072:681.3.06

[Abstract] A circuitry analysis software package is designed on the basis of using the relaxation method to solve sets of nonlinear differential equations. Numerical experimental studies of metal-insulator-semiconductor

(MIS) large scale integrated circuits (LSI) analysis on a unified series (YeS) computer (EVM) demonstrates the efficiency of using the relaxation method of solving ordinary differential equations (ODU) by means of the circuitry analysis software package (KSABRM) with the respect to CPU time and memory volume compared to software packages which realize traditional methods.

Characteristic features of integrated circuits which substantially affect the new method are identified and possible methods of eliminating the undesirable phenomena which decrease the method's efficiency are indicated. Preliminary data on using the KSABRM for analyzing circuits with bipolar elements are obtained. References 8: 4 Russian, 4 Western; tables 2.

Automatic Voice Synthesizer to Warn Repair Crews About Approaching Train

917K0153A Moscow *AVTOMATIKA*,
TELEMEKHANIKA I SVYAZ in Russian No 11,
Nov 90 pp 8-9

[Article by A. Ya. Genin, M. Kh. Tazhirov, Elektronika Section of the Moscow Railroad]

UDC 621.396.2.376:656.2

[Abstract] The specialized Elektronika Section of the Moscow Railroad manufactures on the *khodzraschet* basis and ships to clients the automatic voice synthesizer developed by the authors. It serves as the basis of a warning system which informs repair crews about approaching trains with an unambiguous message perception. The system can be used at multiple track railroad sections. The warning system contains an automatic voice synthesizer (ARI) which is installed in the relay room of the all-electric interlocking system (ETs) as well as elements of operating ETs, a public address system, and a radio station. The ARI design and operating principle are described in detail and its block-diagram is presented. Contract procedures involved in manufacturing and supplying ARI to clients are summarized. The adaptive delta-modulator contained in the ARI and other devices have been granted author's certificates. Figures 1.

UKBM Automatic Diagnostic Test Bench

917K0153B Moscow *AVTOMATIKA*,
TELEMEKHANIKA I SVYAZ in Russian No 11,
Nov 90 pp 9-10

[Article by V. I. Parmenenkov, Elektronika Section of the Moscow Railroad]

[Abstract] The automatic diagnostic bench (ASD) developed by the author is intended for checking engineer alertness monitoring devices (UKBM) at locomotive maintenance centers as well as locomotive depot repair facilities. UKBM serviceability can be analyzed in less than 30 s. Furthermore, the ASD software makes it possible automatically to check all UKBM logical-functional and time parameters as well as switching and electric circuits. The ASD design and operating procedures are described and its block-diagram is presented. The checking software and correct answers are stored in ROM and are compared to real answers to the UKBM checking program, thus producing instant results. The ASD has a self-check capability. The self-check can be run in less than 10 s. To date, 60 automatic UKBM diagnostic benches have been manufactured and shipped to clients. Their operation demonstrates their high reliability and considerably improves the UKBM checking productivity. The ASD has been granted an author's certificate. Figures 1

Management Information Complex for Sorting System

917K0153C Moscow *AVTOMATIKA*,
TELEMEKHANIKA I SVYAZ in Russian No 11,
Nov 90 pp 11-14

[Article by Ye. M. Shalit, T. M. Zibrova, V. V. Yeliseyev, T. Ye. Moskvicheva, A. A. Dolzhenkov]

[Abstract] Standard sorting yard management information systems (ASUSS) are widely used in the country's railroads. They are intended for managing the operation of sorting yards while simultaneously supplying concentrated data on the status of the railroad junction at the road and network level to the rail traffic control center. A sorting yard MIS (IUKSS) developed for increasing the reliability and quality of ASUSS source data is described and its function diagram is presented. IUKSS has a four-layer system architecture and utilizes the vertical decomposition principle. The operating principle of each layer is described. Pilot operation of IUKSS at the Nizhnedneprovsk-Uzel station demonstrates that station staff is better informed; the volume of manual operations and telephone calls has decreased due to the automation of message transmission; the time interval between the actual train arrival (departure) and message transmission to ASUSS has decreased from 30 min to five-seven min for the arrival stock and from 20 min to zero for the departure stock. The IUKSS efficiency is determined primarily by a decrease in the car downtime at the station and a reduction in the maneuvering operation volume. This is due to an increase in the reliability of data and their timely transmission to the upper layer system and station staff; an increase in the information density and coordination of operating personnel; automation of train uncoupling and sorting; and efficient selection of the train uncoupling and dispatching priority. Figures 2; tables 3.

Consolidated Bench for Checking All-Electric Interlocking System With Stored Program Module

917K0153D Moscow *AVTOMATIKA*,
TELEMEKHANIKA I SVYAZ in Russian No 11,
Nov 90 pp 23-26

[Article by Yu. V. Tsyganov, N. I. Yelin, Belorussian Railroad]

[Abstract] The consolidated bench for checking all-electric interlocking system (ETs) units with a stored program module makes it possible to check the electric characteristics of ETs units and unit resistors in a semiautomatic mode, check the ETs unit assembly in an automatic mode, and monitor the transmission of instructions (the acknowledgement mode). The use of the stored program module makes it possible to shorten the time for checking ETs units and decrease the probability of electrician errors which are possible during manual operations with the bench. The module makes it possible to test 19 ETs modules; the program employs 251 instructions which can be divided into six groups by

their purpose. The purpose and execution of all instructions are described. In order to operate the consolidated bench together with the stored program module, keys and switches are replaced with relay circuits which are identical to the circuit design of the consolidated bench. The bench is equipped with a display to facilitate electrician operations and enable him to monitor the ETs checking process. The module is connected to the bench by nine cables. Figures 3; tables 1.

First Fiber Optic Communication Line for Railway Transport

917K0153E Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ in Russian No 11, Nov 90 pp 26-29

[Article by V. I. Vasilyev, V. I. Ptichkin, V. V. Shmytinskiy]

UDC 621.315:621.3.029:656.2

[Abstract] Continuation of an article in *Avtomatika, telemekhanika i svyaz* No. 9, 1990. Pilot operation of a fiber optic communication line (VOLS) in one of October Railroad sections is examined from the viewpoint of determining the outlook for using fiber optic transmission lines (VOSP) in the railway transport communication network. Pilot fiber optic line circuit (VOLT) equipment - an important functional component of VOSP - is described. It differs from the commercially produced Sopka-2 digital VOSP equipment in that no unmanned regenerators and remote power supply are required for its operation. The design and functioning of terminal and line equipment is described. VOSP contains an optical signal emitter and a photodetector. The former is an ILPN-202 semiconductor laser operating in the 1.2-1.3 μ band and the latter is an avalanche photodiode. VOLS startup and pilot operation show that the optical transmitter is the least reliable part of the system due to the poor transmitter design and unreliable operation of the ILPN-202 laser. The results of line equipment measurement parameters are analyzed. The results of pilot operation of the first fiber optic transmission line in a railroad are summarized and the need to solve certain organization problems is identified, especially the lack of skilled professionals at all stages of VOSP implementation, from design and construction to operation. Figures 4.

Integral Equations for Calculating Plane Electromagnetic Fields

917K0215A Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 10, Oct 90 pp 21-30

[Article by Oleg Vladimirovich Grimalskiy, candidate of technical sciences, senior scientific associate, Moldavian Academy of Sciences, Kishinev]

UDC 621.3.013.22.001

[Abstract] A set of integral equations is derived for calculating the plane electromagnetic field in an array of thin long strips and thin wide shells as well as the impedance and e.m.f. matrix of such an array. These equations are derived from the fundamental field equations $\text{div } E^{0,i} = \text{div } H^{0,i} = 0$, $\text{curl } E^{0,i} = -\omega\mu_{0,i}H^{0,i}$, $\text{curl } H^{0,i} = 0$, $\text{curl } H_i = \gamma_i E_i$ (superscript "0" referring to free nonconducting space, superscript "i" referring to conducting strips and shells, ω - frequency of field, μ - magnetic permeability, γ - electrical conductivity, $j = -1^{1/2}$) for an array of N long strips and wide shells with arbitrary x,y profiles in an alternating external magnetic field. Each element has a thickness and a length of contour characterizing its geometry as well as a magnetic permeability and an electrical conductivity characterizing its material. An electric current is assumed to flow in each shell and the skin effect in ferromagnetic strip is taken into account. While these equations are reduced to a system of two Helmholtz equations for E' and H' respectively, a magnetic vector potential is introduced which consists of two additive components representing the external field and the field induced by the currents in shells respectively. The condition of continuity is, moreover, stipulated for the tangential components of the electric field at boundaries of the elements so that its longitudinal z-component becomes independent of the longitudinal z-coordinate and a function of the transverse x,y- coordinates only. The resulting integral equations and boundary conditions can then be approximated by a system of linear algebraic equations for the charge densities of electric single and double layers. For a qualitative analysis, the integral equations are applied to asymptotic cases with known patterns of magnetic field distribution: single strip and two parallel adjacent identical strips of a ferromagnetic material with an infinitely high electrical conductivity carrying a zero net current each in an alternating external magnetic field. For a quantitative accuracy analysis, the integral equations for a cylindrical shell in a uniform alternating external magnetic field were reduced to a system of linear algebraic equations by the Krylov-Bogolyubov method of piecewise-constant approximation and then solved numerically. The results were compared with those of an analytical solution and the discrepancy with regard to the resulting magnetic field both inside and outside the shell did not exceed 2 percent for $0 \leq \omega \leq \infty$, $0 \leq \gamma \leq \infty$, $\mu_0 \leq \mu$. Figures 4; references 5.

Performance Analysis of Electrical Engineering Apparatus by Hypergenerator Method

917K0215B Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 10, Oct 90 pp 31-34

[Article by Vasilii Maksimovich Nikolayenko, candidate of technical sciences, docent, Odessa Polytechnic Institute]

UDC 621.3.012:681.332

[Abstract] Application of mathematical hypermodels to multivariate computer-aided performance analysis of electrical devices is outlined, the performance analysis necessarily including the effect nonelectrical destabilizing factors such as temperature, pressure, and vibrations. Inasmuch as electrical devices are generally represented by equivalent nonlinear circuits, these circuits include mutually independent current and voltage response generators. Each generator is expressed as a vector of operators $\Omega_{i1}(\cdot) = \text{Int}(\cdot)dt$ over time from 0 to t , $\Omega_{i0}(\cdot) = (\cdot)$, $gQ_i = d(\cdot)/dt$ on a vector of nonlinear analytic in time $t \geq 0$ functions f_r ($r = 1, \dots, q$) of currents $i_{1, \dots, m}(t)$, voltages $e_{1, \dots, n}(t)$, and nonelectrical influencing factors $P = \{\text{begin set}\}P\{\text{end set}\}_{1, \dots, P_C}$. For an analysis of dynamic characteristics the method can be simplified by appropriately limiting the number of operating levels as well as the transient response operator. The method is demonstrated on a nonlinear circuit: parallel varistor $F = \alpha v_F^{-2}(t)$ and varactor $Q_1 = \alpha v_{Q1}^{-2}(t)$ combination in series with a current source and a varactor $Q_2 = \beta [v_{Q2}(t)]^{1/2}$ in parallel across an impedance load $Z = \beta [v_Z(t)]^{1/2}$, where $\alpha = A(P)$, $\beta = B(P)$, and $v_{F, Q1, Q2, Z}$ voltages across respective circuit elements. Figures 4; references 4.

Calculation of Magnetic Field in Inductor End Zone of Alternator With Tangentially Polarized Permanent Magnets

917K0215C Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY.
ELEKTROMEKHANIKA in Russian No 10, Oct 90
pp 38-43

[Article by Boris Semenovich Zechikhin, doctor of technical sciences, professor, and Nina Pavlovna Starovoytova, candidate of technical sciences, senior scientific associate, Moscow Institute of Aviation]

UDC 621.313.1/3:621.318.2

[Abstract] Design of electrical machines with tangentially polarized permanent magnets made of rare-earth materials is considered, one of their characteristics being an inductor with highly defined ferromagnetic pole faces in the two end zones responsible for about 20 percent of the total magnetic leakage flux. Mechanical strength of the inductor is usually ensured either by a bimetallic yoke consisting of ferromagnetic pole shoes and nonmagnetic interpolar spacers or by fastening the ferromagnetic pole pieces without shoes to a nonmagnetic sleeve or to the shaft. Calculation of the magnetic leakage flux in the end zones being an essential part of the design procedure, the problem is treated as a three-dimensional field problem and solved analytically upon introduction of a magnetic scalar potential $U(r, \theta, z)$ which satisfies the Laplace equation in cylindrical coordinates with appropriate boundary conditions. That equation is solved by separation of variables once letting $U(r, \theta, z) = U(r, z)\Phi(\theta)$ and again letting $U_n(r, z) = R_n(r)Z_n(z)$, only the sine harmonics

$U_n(r, z)\sin(n\theta)$ existing in the series expansion of the magnetic potential under odd-function boundary conditions. The equation is thus reduced to a system of two: Bessel equation in R_n and simple second-order equation $\delta^2 Z_n / \delta z^2 - \lambda^2 Z_n = 0$ in Z_n . Its particular solutions are $U_{n\lambda} = R_{n\lambda}(r)Z_{n\lambda}(z) = [A_{n\lambda}J_n(\lambda r) + B_{n\lambda}N_n(\lambda r)](C_n \sinh \lambda z + D_n \cosh \lambda z)$, the unknown coefficients A_n, B_n, C_n, D_n being determined from the boundary conditions. The magnetic leakage flux is then calculated from the magnetic potential for specific geometrical parameters of the inductor active and end zones. For illustration are shown results of numerical calculations for 14-pole and 18-pole alternators. Figures 3; references 4.

Programs for Optimal Design of High-Frequency Inductor Generators

917K0215D Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY.
ELEKTROMEKHANIKA in Russian No 10, Oct 90
pp 58-60

[Article by Aleksandr Nikolayevich Arkhipov, candidate of technical sciences, docent, Lyubov Ivanovna Arkhipova, scientific associate, and Nikolay Fedorovich Yevsin, candidate of technical sciences, Novocherkassk Polytechnic Institute]

UDC 621.313.322+519.67

[Abstract] A set of programs has been written for optimal design of high-frequency inductor alternators by the method of random search with adaptation. The design problem is mathematically reduced to a minimization problem, namely finding the optimum point x^* (x -vector of variable parameters) and the corresponding value of the target function $F(x) \rightarrow \min \rightarrow x^*$ in domain $D_1: \psi_j(x) \geq 0$ ($j = 1, 2, \dots, l$) under constraints which define the allowed region $D: \psi_i(x) \geq 0$. There are 14 variable parameters (stator OD, ratio of stator ID to stator OD, relative width and height of stator tooth, width of air gap, length of space between stator stacks, sleeve OD, power factor $\cos \psi$, ratio of number effective conductors-per-slot to number of parallel armature winding paths, current density in armature conductors, number of field winding turns, and magnetic induction in air gap at no load, in yoke behind stator stack, and in yoke between stacks respectively). The constraints encompass technical specifications, structural limitations, technological limitations, and design features. Six of them define the acceptable region D_1 and eleven constraints define the allowed region D . As target function can be selected minimum overall volume or weight, maximum efficiency, minimum weight of armature copper, or minimum weight of field and auxiliary winding copper. The program package consists of subprograms MODEL: alternator checkout design in accordance with manufacturing standards, SLPSOB: finding minimum of target functions by method of random search with adaptation.

PK: design of armature and field windings with adjustment of conductor diameter according to table, PAZ: dimensioning trapezoidal slot, HFE: calculating magnetic field intensity for given grade of steel, INT1 and INT2 interpolating tabulated given function of one or two variables. These programs are written in FORTRAN-4 for the Inductor Alternator computer-aided design subsystem. For illustration are shown results of design calculations on a Standard System 1045 computer for a GPS-16/3000 inductor alternator weighing 4.7 kg with a 3.7 dm³ volume of active materials. The MODEL subprogram was accessed 214 times and the total computer time, with only 11 parameters varied, was shorter than 40 s. Tables 2; references 3.

Reconnection of Induction Motor to Frequency Converter During Buildup of Magnetic flux

917K0215E Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY
ELEKTROMEKHANIKA in Russian No 12, Oct 90
pp 61-66

[Article by V. I. Shutskiy, G. I. Babokin, D. M. Shprekher, and V. A. Stavtsev]

UDC 621.316.925

[Abstract] Switching an induction motor from the main frequency converter to a standby one is analyzed, the problem being a high inrush current. The entire operation involves use of tracking instruments for monitoring both magnitude and angular velocity of the stator e.m.f. vector, both magnitude and angular velocity and the magnitude of the converter output voltage vector, then ensuring that the two vectors with equal magnitudes and angular velocities are in phase opposition at the instant of switch reclosure. The converter output voltage at the motor terminals and the motor speed, which had dropped upon opening of the switch, will subsequently both rise exponentially if the magnetic flux remains constant. A switching procedure is proposed which will limit the inrush current to one and a half times the nominal full-load full-speed current and thus to the overload capacity of conventional converter thyristors, namely reconnecting the motor while the magnetic flux in it is already small and then making it build up exponentially. Analysis of the entire disconnect-reconnect process is based on a mathematical model which takes into account magnetic saturation of the motor iron along the path of the main magnetic flux. The initial conditions for disconnection are established by solving the equations of steady state prior to disconnection from the main frequency converter. The initial conditions for reconnection are established by solving the equations of transient state during motor coasting with attendant decay of the magnetic flux. The solution of altogether 10 equations has been programmed for an Elektronika DZ-28 microcomputer and was tested on a 1.5 kW induction motor. The results of calculations indicate that the magnetic time constant of such a motor

should not be longer than 0.3 s, the phase opposition of the two rotating vectors should be accurate within 15°, and the difference between their angular velocities should be measured with an 8 percent or better accuracy. Figures 3; references 3.

Dynamics of Controlled Solenoid Motor

917K0215T Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY
ELEKTROMEKHANIKA in Russian No 10, Oct 90
pp 74-79

[Article by A. I. Tolstik, scientific associate, V. I. Malinin, candidate of technical sciences, senior scientific associate, and A. N. Ryashentsev, Institute of Mining, Siberian Department, USSR Academy of Sciences, Novosibirsk]

UDC 621.318.3

[Abstract] The performance of solenoid motors for electromagnetic hammers, presses, or hand tools is analyzed on the basis of motor dynamics, considering that the dynamic efficiency of such a motor is maximum when only electromagnetic energy converts into work while the energy stored in the magnetic field W_M remains constant: $dW_M = i d\theta + \theta di = 0$ (i - current, θ - flux linkages). In order to satisfy this second requirement, it is necessary to determine how the armature current or voltage varies along the armature trajectory. Solution of that differential equation yields the armature current $i = W_s / \theta$ ($W_s = i_0 \theta_0$, subscript "0" referring to initial values). In order to satisfy the first requirement, it is necessary that the armature current vary so as to remain inversely proportional to the flux linkages with W_s as the proportionality factor. The problem is solved analytically for a shell-type motor, taking into account that the flux linkages, which are difficult to measure during motion of the armature, depend not only on the armature current but also on the armature displacement and thus on the armature velocity $v = dx/dt$. Solution of the differential equation for $v \cdot dv$ yields an algebraic expression for v . The dependence of both armature velocity and motor efficiency on the load and on the energy stored in the magnetic field was evaluated numerically using the fourth-order Runge-Kutta approximation scheme. The results indicate that operation at maximum efficiency is attainable by storage of energy in the magnetic field before the motor has been started and by regulation of the control voltage with a transducer depending on the armature velocity at given points on the trajectory, on the load, and on the required response speed. Figures 5; references 2.

Design of Magnetic System for Magneto-electronic Devices

917K0215G Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY
ELEKTROMEKHANIKA in Russian No 10, Oct 90
pp 79-83

[Article by V. A. Zablotskiy, assistant, and Yu. A. Mamaluy, doctor of physical and mathematical sciences,

professor, Donetsk State University, K. V. Lamonova, research trainee, and G. F. Temerti, candidate of technical sciences, Donetsk Institute of Engineering Physics at UkSSR Academy of Sciences]

UDC 621.382.001.24

[Abstract] A method of designing the magnetic system for magnetoelectronic devices such as cylindrical-magnetic-domain memories with maximum economy of material is outlined, the essential requirement being to ensure a given magnetic field intensity distribution in the main air gap. The basic problem is to determine the dependence of this distribution on the geometrical dimensions, most critical being thickness of the magnet and width of the air gap. The method is demonstrated on a magnetic structure which consists of a permanent-magnet plate resting symmetrically on a magnetic core in the form of a flat rectangular channel which acts as a shield and closes the flux path. The magnetic field in this

system is the main field of the permanent magnet and the leakage field of that shield. In accordance with the uniqueness theorem, the leakage field is equivalent to the field produced by mirror images of the magnet. A valid application of this principle requires assuming an infinitely long core and an infinitely high magnetic permeability of its material. The first condition is closely enough approximated by a core with end segments beyond the magnet plate much longer than the air gap (channel height). The second condition is closely enough approximated by a core made of a soft magnetic material. Calculations on this basis have been programmed in FORTRAN language. In a numerical experiment with a 1.5 mm thick and 20 mm square magnet plate on a 31 mm wide core (channel) the air gap (channel height) was varied from 2 mm to 10 mm. The results indicate the feasibility of replacing two magnets with one and thus reducing the size as well as the material content without degrading the performance. Figures 5; references 8.

Ultraviolet Ladar for Ozone Probing

917K0198A Tomsk OPTIKA ATMOSPHERE in Russian
Vol 3 No 10, Oct 90 pp 1056-1059

[Article by I. G. Shurygin, N. S. Belokrinskiy, V. M. Lagutin, and V. N. Sobolev, Kharkov Institute of Radio Electronics imeni Academician M.K. Yangel]

UDC 528.8.044.6

[Abstract] A high-resolution ladar using an excimer XeCl-laser for probing the ozone layer with 308 nm radiation is described which makes it possible to measure the altitudinal profile of ozone concentration with a 0.1 km altitude resolution and to track its changes in time. The principle of such a measurement is based on the equation of one-wavelength laser location, which yields an expression for the altitude dependence of the ozone concentration. The optical part of the apparatus consists of a XeCl-laser in a cavity between two mirrors, a rotary mirror, a Newton zenith receiver telescope, an interference filter, a motor-driven mechanical shutter which suppresses backscattering interference, a photomultiplier, and two photodiodes. The photomultiplier feeds electric signals through a preamplifier and a generator of height interval signals to a multichannel recording instrument. The photodiodes feed electric signals to a gate pulse generator with a quartz oscillator which generates synchronization pulses for starting both the recording instrument and the laser. The generator of height interval signals and the preamplifier share another power supply. Measurements made with this ladar made in 1986 over the Tuapse health resort town have yielded ozone concentration profiles up to 30 km altitude, with a maximum O_3 molecule concentration of $6.5 \times 10^{12} \text{ cm}^{-3}$ within the 22-24 km range. The error of measurement at lower altitudes was small, the cross-section for absorption of 308 nm radiation by aerosol being only $5.8 \times 10^{-26} \text{ cm}$ as compared with $1.3 \times 10^{-19} \text{ cm}^2$ for its absorption by ozone. Simultaneous control measurements were made with a ladar using a 589 nm dye laser. Analogous measurements are now being made over Tomsk. Figures 2, references 7.

Effect of Atmospheric Turbulence on Air Humidity Measurement by Radioacoustic Amplitude Method

917K0198B Tomsk OPTIKA ATMOSPHERE in Russian
Vol 3 No 10, Oct 90 pp 1064-1069

[Article by S. I. Babkin and G. V. Grusha, Kharkov Institute of Radio Electronics]

UDC 621.395.551.501.721

[Abstract] Measurement of the relative air humidity by vertical radioacoustic probing at two frequencies is analyzed for the effect of atmospheric turbulence, its effect on the accuracy of such a measurement being usually

minimized by selecting the ratio of amplitude distribution modes within the averaging period as the characteristic quantity. An analysis of numerous amplitude readings having revealed an extremely wide diversity of amplitude distribution histograms, however, it therefore is proposed to use the difference between sound absorption coefficients as the characteristic quantity and to calculate this difference from the ratio of mean maximum power readings at the Bragg angle at each altitude. The method is analyzed for accuracy under conditions of no correlation between air temperature and wind velocity fields, assuming a negligible effect of humidity fluctuations above dry land. The structural constant of the acoustic refractive index is calculated accordingly for a sound beam narrower than its path length, this constant C^2 being equal to $C_T^2/4T^2 + C_V^2/c^2$ (T - absolute temperature of air, V - absolute velocity of wind, c - speed of sound in air). The shift of difference between sound attenuation coefficients due to wind and turbulence is then calculated for weak turbulence with C^2 of about $10^{-8} \text{ m}^{-2/3}$ and strong turbulence with C^2 of about $5 \times 10^{-8} \text{ m}^{-2/3}$ at 100-200 m. The dependence of this shift on the frequency of the probing signal and on the distance to the target region as well as on C^2 is established for nearly still air and in a moderate cross wind wind, this relation involving also the coherence lengths of the sound beam and the effective diffractive width of the radio beam and sound beam interaction spaces. Numerical calculations are made on this basis covering the 50-200 m altitude range and humidity up to 100 percent in still air and at a 5 m/s horizontal wind velocity. Three measurements are considered, using different sets of two acoustic frequencies f_1 and $f_2 = 2f_1$: 1) 1.7 kHz and 3.4 kHz, 2) 3.4 kHz and 6.8 kHz, 3) 6.8 kHz and 13.6 kHz. According to these estimates, the absolute error of measurement of relative humidity increases as the latter increases. Wind compounds this error, except when measurements are made using the top frequencies (6.8 kHz and 13.7 kHz) and its effect is then compensated by strong turbulence. The relative error does not exceed 10 percent at 3.4-13.6 kHz frequencies in still air even at high humidity levels, but at a wind velocity of 5 m/s it does not exceed 10 percent excepts only at 6.8-13.6 kHz frequencies. Figures 4, references 9.

High-Sensitivity Gated Television Apparatus for Image Recording

917K0198C Tomsk OPTIKA ATMOSPHERE in Russian
Vol 3 No 10, Jan 91 pp 1102-1107

[Article by B. D. Borisov, V. M. Klimkin, V. A. Krutikov, A. A. Makarov, G. V. Fedotova, and V. A. Chikurov, Institute of Atmospheric Optics, Siberian Department, USSR Academy of Sciences]

[Abstract] A gated television system for image recording has been built which consists of a high-sensitivity supervidicon transmitter camera coupled to a microchannel-plate luminance intensifier and also a cathode-ray storage tube. High luminous sensitivity is ensured by

ability of the luminance intensifier to register one-electron events. Time gating of the register is made possible by powering the intensifier with high-voltage pulses. The minimum exposure time, determined by the gate pulse generator, is 100 ns. The cathode-ray tube can store images of hundreds of frames and read the sum signal in the television standard. The apparatus was tested with an LPI-103 injection laser, this laser being started by frame synchronization pulses and emitting $\lambda \approx 0.9 \mu\text{m}$ radiation in pulses of $E \approx 5 \mu\text{J}$ energy and $\tau \approx 200$ ns duration within a beam with a $2\alpha \approx 40^\circ$ divergence angle. The apparatus included a rotary mirror, a Foucault raster with variable space frequency on a target plate as the test object, a receiver objective followed by an infrared light filter, the luminance intensifier, a pair of Gelios-44-2 objectives, the supervidicon in a commercial PTU-50 mount, the cathode-ray tube with an UP-4 memory, a video monitor, and the high-voltage gate pulse generator preceded by a delay line. The distance from the test object to the receiver objective was 821.0 cm and the area covered by an image of the test object on the intensifier photocathode was 0.6 cm^2 . The test data

were processed by a single-board microcomputer and an SM-4 minicomputer with a memory capacity of four image half-frames in the $250 \times 256 \times 6$ -bits format. According to calculations based on the theoretical approximate relation, one laser pulse delivered to the intensifier photocathode an energy $E \approx 0.9 \text{ fJ}$ or $N \approx 45,000$ photons. With only 45 one-electron events registered during an exposure, the quantum efficiency of the viewing system did not exceed a $Q \approx 10^{-3}$. Calculation of the contrast $K = (A_{\text{white}} - A_{\text{black}}) / (A_{\text{white}} + A_{\text{black}})$ (A -amplitudes of both signals at the centers of their respective bands) reveals that the maximum number of resolvable line pairs as well as the minimum number of storable image frames necessary for achieving this maximum resolution depend on the energy input to the intensifier photocathode and that the threshold energy is $E_{\text{min}} \approx 0.1 \text{ fJ}$. The contrast improves with increasing number of storable image frames, as the contrast-frequency characteristics calculated for 100, 400, 500 frames indicate, and is even better in the current mode with $E \approx 2.5 \text{ pJ}$ energy input to the intensifier photocathode. Figures 5; references 6.

On Correctness of Differential and Difference Composite Problem Formulations for Geophysical Cable

917K0213A Tashkent DOKLADY AKADEMII NAUK UzSSR in Russian No 9, Sep 90 pp 9-12

[Article by R. O. Alayev, M. Yu. Sadykova. Tashkent Order of the Red Banner of Labor State University imeni V. I. Lenin; submitted by Academician of the Uzbek Academy of Sciences V. K. Kabulov]

UDC 517.9:621.315.211.9

[Abstract] The problem of calculating the dynamic force on a geophysical cable used for multiple lowering of instruments into a well and transmitting their signals to devices on the surface is addressed. The upper end of the cable is either fastened or wound around a drum while a load with a given mass is suspended from the lower end; the drum rotates at a given circumferential velocity. A compound problem of finding the cable's longitudinal vibrations and boundary value conditions is formulated. Two theorems are proven: if a classical solution of the compound problem exists, it is unique; if the boundary value parameters meet certain conditions, the proposed difference method is stable. The proof of the latter theorem is based on plotting a difference analogue of the dissipative energy integral. References 4; figures 1.

Intelligent Functional VLSI Circuit Synthesis System

917K0213B Tashkent DOKLADY AKADEMII NAUK UzSSR in Russian No 9, Sep 90 pp 15-16

[Article by T. F. Bekmuratov, Uzbek Academy of Sciences]

UDC 681.32:621.32

[Abstract] Issues of functional synthesis of VLSI circuits (SBIS) with up to 10^6 - 10^9 logic elements on a chip are addressed. An intellectual system designed on the basis of tested engineering circuit development methods, an inventory of standard elements and units, and dialog resources for the user interaction with the synthesis

system is described. The knowledge of synthesis methods and algorithms and standard element and unit circuits accumulated by experts in digital integrated circuitry was used to develop the system intended for synthesizing a wide range of digital functional units and devices (TsFUU), e.g., registers, counters, frequency dividers, decoders, adders, shifters, storage, and math coprocessor devices. The system contains an intelligent interface and interactive analysis, processing, display, and control facilities as well as a database and a knowledge base. The computer-aided synthesis task amounts to generating or compiling a set of functional diagram versions and finding those which ensure the selection of an optimal circuit according to specifications. The system is realized on VAX (Coulomb-4) and SM-1420 workstations (ARM). The synthesis of one type (out of five-seven verifications) of TsFUU is on the order of three min. Today, work is underway on realizing the system on IBM PC microcomputers. References 4.

Temperature Dependence of Radiation Polarization Conditions in Unimodal Optical Fibers

917K0213C Tashkent DOKLADY AKADEMII NAUK UzSSR in Russian No 9, Sep 90 pp 23-26

[Article by E. A. Zakhidov, M. A. Kasymdzhanov, F. M. Mirtadzhiev, P. K. Khabibullayev, Thermal Physics Department at the Uzbek Academy of Sciences]

UDC 681.7.068

[Abstract] The temperature dependence of the state of radiation polarization in single-mode optical fibers is investigated. In particular, the temperature dependence of the optical activity and linear birefringence of optical fibers with various protective coats and different values of double refraction - the parameters which determine the signal stability in various types of optoelectronic devices - is examined. It is demonstrated that the state of polarization in optical fibers with a weak birefringence, i.e., $\delta n = 10^{-2}$, is extremely sensitive to the external protective sheathing whereas optical fibers with a strong birefringence of $\delta n = 10^{-1}$ are virtually "insensitive" to it. References 5; 3 Russian, 2 Western; figures 1; tables 1.

Digital Frequency Synthesizer

917K0158A Kiev UPRAVLYAYUSHCHIYE SISTEMY
I MASHINY in Russian No 6, Jun 90 pp 3-9

[Article by A. D. Bekh, V. V. Chernetskiy]

UDC 621.373

[Abstract] Design methods and specifications of digital frequency synthesizers are considered and methods of increasing their quality indicators are analyzed. It is shown that a synthesizer can be designed using charge electronics circuits on the basis of a charge integrating amplifier. The synthesizer operating principle and frequency control methods by means of automatic control of the reservoir capacitor recharge current are described. The digital synthesizer does not contain high-frequency harmonic oscillators built on LC-circuits or VLSI circuits; it can be executed on the basis of a solid state chip thus insuring its small overall dimensions and mass and low cost. References 6; figures 2.

Synthesis of Single-Processor Nonrecursive Filters

917K0158B Kiev UPRAVLYAYUSHCHIYE SISTEMY
I MASHINY in Russian No 6, Jun 90 pp 10-16

[Article by Yu. S. Kanevskiy, S. G. Ovramenko]

UDC 681.322.012

[Abstract] The problem of designing single-processor computers using methods based on structural properties of cyclical algorithms, particularly information relations, from data which determine not only the computational sequence in the processor (or processors) as well as the sequence of data input/output, the duration of their storage, and sampling moments, and are the diagnostic variables for timing the execution and interchanges in the computer is considered. The problem of parallel execution is also addressed. Synthesis of devices which realize the nonrecursive filtering algorithm of unidimensional signals is considered. A technique based on space-time mapping of the parallel algorithm into an adequate block diagram is used as the tool. The source algorithm is defined as a high-level language program which is elaborated by a systolic translator. As a result, virtually all acceptable filter designs are produced; among these, designs optimized for the volume of memory used, execution time, and system delay are highlighted. References 5; figures 3; tables 1.

Scientific and Engineering Problems of Providing Telephone Service to Country are Discussed

917K0207A Moscow VESTNIK SVYAZI in Russian
No 10, Oct 90 pp 2-3

[Article by Editors]

[Abstract] A meeting of the Scientific-Technical Council of the USSR Telecommunications Ministry on providing telephone services to the country involving representatives of the Central Communications Research Institute (TsNIIS), the "Krasnaya Zarya" Leningrad Scientific Production Association, the "Kvazar" Scientific Production Association, the All-Union Standardization Research Institute (VNIIS), the Data Transmission Problems Institute (IPPI) at the USSR Academy of Sciences, the "Etalon" Scientific Research Institute, staff from republican communications ministries, etc., is described. Future communication development trends in the country outlined in the Basic Premises of the Third Phase of the Unified Automated Communication System Development (YeASS) for the 13th and 14th five-year plans were discussed. The program calls for installing 60 million telephone sets by 2000, making it possible to provide up to 48 million sets to the public in the 13th five-year plan and 83 million in the 14th. The meeting identified the development and installation of the Unified Switching Equipment System (YeSSKT) as the key task for the 13th five-year plan.

Russia's Communications Industry Calls for Accelerated Development

917K0207B Moscow VESTNIK SVYAZI in Russian
No 10, Oct 90 pp 3-6

[Article by Ye. Konstantinov, Editor in Chief of the Vestnik svyazi]

[Abstract] V. B. Bulgak, the new RSFSR Minister of Telecommunications, Information Services, and Space, is interviewed by the journal's editor in chief. Mr. Bulgak briefly describes his past accomplishments and the chain of events which led to his present appointment. In his opinion he owes his job to the decision by Russian deputies to set up a republican communication ministry and extend its jurisdiction to information processing and space exploration. He acknowledges that Russia occupies no higher than the tenth place in the USSR in the level of telecommunication services and outlines measures necessary to correct this situation. In particular, Mr. Bulgak sees the development of satellite communications as the principal trend in the Far North, Siberia, and Far East. He expects that Russia would be able to purchase the necessary equipment by exporting her secondary raw materials. Prospects for improving the mail and newspaper delivery were discussed. Mr. Bulgak expresses his views on the development of relations between the republican ministry and the center and describes the new functions of his ministry and its organizational structure.

Only at 'Mashpriborintorg' and Nowhere Else

917K0207C Moscow VESTNIK SVYAZI in Russian
No 10, Oct 90 pp 7-9

[Article by Editors]

[Abstract] V. G. Lozhnikov, chairman of the "Mashpriborintorg" foreign trade association and member of the board of the USSR Communications Ministry, is interviewed by the editors of the journal. He discusses the consequences of new economic relations with eastern European countries which are to be conducted in freely convertible currency (SKV) after 1991 and the outlook for exporting his company's output. He acknowledges that it imports ten times as much as it exports due to the country's urgent need for telecommunication equipment. He also addresses the poor quality of eastern European products and the need to import from the West. Mr. Lozhnikov was recently elected chairman of the Italian-Soviet Chamber of Commerce and discusses the role of this organization in the development of trade between Italy and the USSR as well as commercial relations between the USSR and Spain; in particular, he mentions than the first joint venture - the "Telur" in Perm, has begun producing telephone sets which are being sold in the West. He also discusses the negative effect of COCOM technology transfer restrictions on the development and construction of the Trans-Soviet Fiber Optic Communication Line (TSL), especially the ban on supplying 565 Mbit/s equipment.

How to Get Less Tired Sitting Behind Computer Monitor

917K0207D Moscow VESTNIK SVYAZI in Russian
No 10, Oct 90 pp 11-12

[Article by G. G. Rud, G. V. Ostrofets, G. Ye. Friptulyak, V. V. Solodyannikov, Kishinev State Medical School and USSR Telecommunications Ministry]

[Abstract] The factors affecting the work efficiency and productivity of telephone directory assistance operators are discussed. Special attention is given to efficient alternation of work and rest. Physiological and industrial hygiene studies of the work of directory assistance service (SIS) operators conducted in Kishinev are described; the studies reveal that the work and rest schedule affects not only operator health but also other production indicators such as reliability, error rate, and productivity. The study makes it possible to draw the conclusion that SIS operator work is light but stressful or even very stressful with respect to some indicators. The authors suggest that two work schedules be tested in order to reduce stress: 1. working first shift for four days, taking two days off, then working second shift for four days; and 2. working first shift for two days, second shift for two days, then taking two days off. Moreover, they call for taking a 20-25 min break for food after three-three and a half h of work. They also suggest that a seven-eight min break be taken after the first two hours of work and two hours after the meal break. Other short

break versions are also proposed. The mean work productivity measured as the number of directory assistance inquiry responses for all work schedules is compared. Tables 1.

Optimal Urban Telephone Network Design Using MT-20 and EATS-200

917K0207E Moscow VESTNIK SVYAZI in Russian
No 10, Oct 90 pp 37-41

[Article by A. I. Shilman, N. I. Rogushin, Communications Design Institute and Leningrad Branch of the Communication Research Institute]

[Abstract] A methodology manual developed at the Giprosvyaz-2 Institute on the basis of a recommendation of the Leningrad Branch of the Communication Research Institute (LONIS) is described. The manual calls for developing and organizing urban telephone network (GTS) operation using MT-20 and EATS-200 electronic ATX's based on digital transmission systems (TsSP). It is shown that new digital switching technology can be implemented in existing analog GTS's by using the "network superposition" principle whereby a digital network interacting with the existing network through individual tandem exchanges is developed. In so doing, tandem exchanges simultaneously perform the functions of incoming, outgoing, long-distance, and bypass communication centers while the MT-20 and EATS-200 exchanges play the role of rayon exchanges with a limited service area. The new networks employ pulse-code modulation equipment (IKM). Specific network organization principles are described in detail. It is noted that implementation of new types of electronic exchanges in urban

telephone networks calls for reviewing existing recommendations for the design of subscriber loop circuits and long-distance networks. Figures 2.

Single-Fiber Urban Telephone Network Optical Communication System

917K0207F Moscow VESTNIK SVYAZI in Russian
No 10, Oct 90 pp 44-46

[Article by B. Z. Berlin, A. S. Brisker, V. V. Bystrov, V. V. Ilin, Leningrad Urban Telephone Network and Leningrad Branch of the Communication Research Institute]

[Abstract] The capacity of fiber optic communication lines (VOLS) can be increased by forming a monofilament line circuit; to this end, splitters capable of dividing the optical signal power among two or more transmission channels are necessary. Several types of unimodal and multimode splitters and their manufacturing methods are described. It is shown that optical waveguide splitters have the best parameter stability and add the least amount of distortions to the optical emission spectrum; these devices are connected to the input and output system segments either by connector plugs or by optical fiber welding. Specifications of such optical splitters are summarized and measurement data on their characteristics are cited. The possibility of using these splitters for single-fiber transmission system operation was examined by using a 3 km laboratory VOLS equipped with Sonata-2 equipment operating at a $\lambda=0.85$ μm wavelength with a 50 dB energy potential at a 8.448 Mbit/s rate. The results of these experiments which ensure a 50 percent optical fiber reserve of line cable demonstrate the principal possibility and expediency of organizing single-fiber communication by using popular Sonata-2 equipment and optical splitters. Figures 1; tables 3.

Efficient Design Algorithms for Magnetic Circuits of Electromechanical Converters

917K0205A Novocherkassk IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY:
ELEKTROMEKHANIKA in Russian No 12 Dec 90,
pp 19-26

[Article by Gennadiy Konstantinovich Ptakh, candidate of technical sciences, docent, and Inessa Ivanovna Artyukhova, candidate of technical sciences, senior instructor, Novocherkassk Polytechnic Institute]

UDC 519.688:621.314

[Abstract] Two pairs of efficient algorithms for calculating the magnetic fluxes in magnetic structures of electromechanical converters and the magnetic potential differences in equivalent circuits are outlined, one pair according to the method of simple iteration and one pair according to Newton's method of iteration. The schemes of both methods involve linearization of the flux-m.m.f. (weber-ampere) characteristic of the nonlinear structure component on the k-th iteration, using static magnetic permeances or reluctances in the method of simple iteration and differential ones in Newton's method of iteration. The algorithms of each method are applied first to a wound toroidal core with an air gap representing a single loop, the convergence of both iteration processes depending here on the width of the air gap and Newton's iteration process shown to converge faster. Next is considered a small single-phase rotating-field 2-pole synchronous generator with a "dumb-bell" rotor core (salient poles) representing a multibranch structure. Calculations are made here separately for the stator teeth, the stator yoke, and the smooth rotor core. Three calculation schemes are tested on this structure: 1) composite algorithm of simple iteration for magnetic fluxes and magnetic potential differences using static permeances, 2), 3) algorithms of Newton's iteration for magnetic fluxes (2) and magnetic potential differences (3) using differential permeances and an auxiliary m.m.f. in series. Calculations for the toroidal core are demonstrated using five different sets of ampere-turns and gap width, showing the number of iterations needed for the values of magnetic flux to converge within 1 percent. Calculations for the synchronous generator are demonstrated using five different sets of field current and armature current (including no load), showing the number of iterations needed for the magnetic fluxes to converge within 0.1 percent r.m.s. Figures 5; tables 2; references 3.

Design of Automatic Control System With Relay Element for Electromagnetic Suspension

917K0205B Novocherkassk IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY:
ELEKTROMEKHANIKA in Russian No 12, Dec 90
pp 45-48

[Article by Mikhail Mikhaylovich Savin, candidate of technical sciences, docent, Pavel Aleksandrovich Padalko, junior scientific associate, and Yuriy Aleksandrovich Nikitenko, candidate of technical sciences, docent, Novocherkassk Polytechnic Institute]

UDC 621.335:625.2.013

[Abstract] A regulator with a relay element and inertial feedback for an electromagnetic suspension is designed in accordance with the theory of automatic control using the method of transfer functions. The open-loop amplitude-frequency characteristic is calculated first, the parameters of the closed-loop system then being calculated on the basis of performance requirements. Analytical calculations are supplemented with numerical data assuming that 500 Hz is the maximum allowable oscillation frequency for transistors of the force transducer to remain operational and consequently allowing 0.14 V wide insensitivity zone. An only 0.02 V wide insensitivity zone is not feasible, owing to difficulty in the necessary relay tuning. Figures 2; references 2.

Computer Simulation of Electromagnetic Field in Laminated Cylindrical Iron Structures During Inductive Heating

917K0205C Novocherkassk IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY:
ELEKTROMEKHANIKA in Russian No 12, Dec 90
pp 57-61

[Article by Yuriy Alekseyevich Bakhvalov, doctor of technical sciences, professor, and Aleksandr Vitalyevich, engineer, Novocherkassk Polytechnic Institute, Nikolay Ivanovich Berezinets, candidate of technical sciences, senior scientific associate, All-Union Scientific Research Institute of Electrical Engineering, Novocherkassk]

UDC 621.313.33

[Abstract] Heat treatment of winding insulation in electrical machines during stator and rotor assembly or maintenance operations by inductive heating with a current of commercial frequency is considered, an appreciable economy of time being achievable by use of eddy currents induced by the alternating magnetic field of the inductor as the source of heating power. The principle is demonstrated by simulation of this process on a cylindrical physical model: a cylindrical wound inductor around the rotor or inside the stator. The mathematical model for computer-aided solution of the field plotting equations by the method of finite elements (isosceles triangles) and Galerkin's method is based on given line voltage and frequency, current density in inductor coils, width of the air gap, geometrical dimensions of armature and inductor, and electrical properties of active materials. Assumed are, furthermore, a linear medium and a uniform current density distribution in the inductor coils. The laminated rotor of stator core is replaced with an equivalent electrically and magnetically anisotropic body. The equivalent axial and radial magnetic permeability of iron (steel) in a steady magnetic field, and its electrical conductivity in a quasi-steady one, are calculated accordingly on the basis applicable field equations. Design of the inductor and its winding can then proceed by calculation of the core loss power due to eddy currents and thus also of the temperature rise. The calculation

algorithms have been programmed in FORTRAN-4 for a Standard System 1045 computer, only one quadrant of an axisymmetric electromagnetic field needing to be plotted. This field simulation procedure has been tested for accuracy by comparing the results of computer experiments with those of physical experiments, the difference not exceeding 6 percent for an NB-110 d.c. machine with a laminated armature stack and an air-core inductor. Figures 2; references 2.

Method of Organizing Multiprocessor System Tasks

917K0205D Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 12, Dec 90 pp 87-90

[Article by A.Yu. Shcheglov]

UDC 621.37/39

[Abstract] A method of organizing the operations of a multiprocessor system of identical devices operating in parallel is proposed which requires a much smaller amount of calculations and much less computer time than the conventional method based on repeated reassignment of tasks to the individual processors. The problem of organizing the multiprocessor operations is treated as a problem of discrete optimization. The algorithm of this method involves essentially nine steps readily implemented on a computer according to standard procedure. It is formulated for a system of $n = 1, \dots, N$ processors performing $m = 1, \dots, M$ operations in a time T_m each. The problem is to devise the optimum plan of task assignment for minimum difference $\Delta T = \max [\text{begin set}] P_{n\pm} - T_{n\pm a} [\text{end set}]$, where $T_{n\pm}$ denotes the total time spent by the n -th processor and $T_{n\pm a}$ denotes the average total time spent on performing M tasks. The nine steps include ranking the of M operations in the order of increasing length, identifying the "shortest" operations, setting up a preliminary plan for assignment of tasks, and repeated reassignment of tasks, if necessary, until the condition $\Delta T \leq \min \Delta T$ is satisfied. The procedure is illustrated on a specific example of $N = 4$ processors for $M = 17$ tasks. Its advantages are a completely formalized algorithm not requiring human intervention and simplifying the optimization process being reduced it to solution of linear equations. From the "not worse" plans, moreover, may be selected the one where $\Delta T \rightarrow \min$ so that computations can be terminated sooner as this condition rather than $\Delta T \leq \min \Delta T$ is satisfied. Tables 2; references 1.

Selecting Solar Collector Materials

917K0212A Tashkent GELIOTEKHNIKA in Russian No 5, Sep-Oct 90 pp 12-17

[Article by I. M. Abuyev, B. V. Tarnizhevskiy, State Science Research Institute of Power Engineering imeni G. M. Krzhizhanovskiy]

UDC 662.997:537.22(088.8)

[Abstract] Design shortcomings of domestic solar collectors resulting in their declining sales are identified and certain performance indicators of the main solar collectors made at the Bratsk Heating Equipment Plant (BZOO) and Baku Nonferrous Metals Processing Plant are compared. It is shown that these products have a small area, a large specific mass resulting in a high specific material consumption, and short service life. Foreign design recommendations for using high-quality materials and modern technologies are summarized and various materials used for absorbing panels, primarily steel, aluminum alloys, and corrosion resistant steel as well as brass-based alloys and plastics are compared. Transparent glass, polycarbonate, and polyethylene and fluoride film coats and their properties are evaluated. Heat insulation materials are estimated and compared to each other. It is shown that much attention must be given to selecting the absorbing panel material since errors in this process may lead to a rapid and complete failure of the collector and the entire solar heating system. The authors state that these data reflect their own viewpoint and are based on the experience of their own solar collector designs as well as the information available to them at the time. References 7; 5 Russian, 2 Western; tables 4.

Statistical Analysis of Solar Energy Collector Patent Fund

917K0212B Tashkent GELIOTEKHNIKA in Russian No 5, Sep-Oct 90 pp 24-27

[Article by A. N. Smirnova, All-Union Patent Examination Science Research Institute]

UDC 662.997

[Abstract] Invention development trends toward using solar energy in the USSR and abroad are analyzed on the basis of a standard methodology for solar energy collectors - the most common solar engineering devices - in order to determine the most promising trends in this field and provide the necessary data to designers. Countries with the best-developed power engineering base, i.e., the USSR, the United States, the FRG, France, Great Britain, Japan, and Switzerland, are selected for identifying patent and specifications documents. Data on a 13-year period of 1975-1987 for the basic International Invention Classification (MKI) class F24 J2/00-2/52 were analyzed. In addition, class F24 J3/02 was analyzed for the foreign patent fund prior to 1985. Flat-plate and focusing collectors, building structure component and pool collectors, collectors with evaporation and condensation processes, and evacuated tubular and mobile collectors and their design specifications and patent descriptions are analyzed. The analysis of the inventor activity in the field of solar energy collector development demonstrates that the number of patent

documents is directly related to the demand for collectors and increases in the countries where practical applications of solar engineering devices are the greatest. References 2; figures 4; tables 1.

Investigation of Space-Time Transient Process Regularization in Solar Collector

917K0212C Tashkent GELIOTEKHNIK in Russian
No 5, Sep-Oct 90 pp 28-31

[Article by L. N. Stronskiy, A. V. Suprun, Electrodynamics Institute at the Ukrainian Academy of Sciences]

UDC 662.997

[Abstract] Basic theoretical premises of the space-time regularization of the transient thermal process in a multicomponent entity are cited and the results of an experimental investigation of transient processes in various elements of a solar collector device are presented. The authors investigated experimentally the regularization processes occurring in a laboratory model of a "hot box" solar collector (GU) with a 0.04 m² total frontal area made as a wooden box lined with polyurethane foam insulation which houses an absorbing plate separated from the insulation by an air gap; the plate's working surface is covered by a selective copper oxide coat. Hot junctions of three thermocouples were installed in the box while the cold junctions were maintained at a constant 0°C temperature. Measurements were taken by a V7-21 digital voltmeter. The transient process regularization in GU was studied with the help of the ϕ criterion which characterizes the degree of the transient process completion. The mean water temperature in a flow-type GU whose value is close to the receiving panel temperature was used as the output variable; it is shown that this quantity meets the optimal conditions for identifying the thermal energy characteristics of the GU on the basis of the dynamic method; moreover, the experimental water heating curve on the GU outlet may be used for identifying the GU unit step function coefficients for the "sun-water" path. References 7; figures 2; tables 1.

Characteristics of Gallium Arsenide-Based Photoconverters With Double-Sided Sensitivity

917K0212D Tashkent GELIOTEKHNIKA in Russian
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[Article by M. A. Abdukadyrov, N. F. Akbarov, Kh. Kh. Bustanov, A. S. Ganiyev, M. Mirzabayev, Engineering Physics Institute at the "Fizika-Solntse" Scientific Production Association of the Uzbek Academy of Sciences]

UDC 621.383.621.315.592

[Abstract] Photoconverters capable of generating electric current when they are illuminated on both sides are examined; they are useful under both space a ground

conditions since their use improves specific characteristics and performance capabilities of power plants. Double-sided heterostructures (DGS) on the basis of GaAs-AlGaAs with one separating *p-n* GaAs homojunction help to realize most fully the principal advantages of this type of photoconverters. The DGS's under study were made by epitaxial liquid phase precipitation of *n-n-p-p* layers on GaAs and GaP substrates with a (100) orientation. Photoelectric characteristics of structures separated from the GaAs single crystal substrate and monolithic structures with a transparent GaP substrates were investigated. It is shown that the short circuit current of nonoptimized heterostructures under a single-sided exposure to 15-20 mA/cm² increases by 1.5-2 times in the case of a double-sided exposure given a 0.9-1.0 V *p-n* junction's open circuit voltage. The results show that it is possible to develop double-sided photoconverters with DGS; these converters' advantages include their high transmittance to long-wave radiation beyond the main absorption band edge which makes it possible greatly to decrease nonphotoactive absorption, prevents the premature structure heating under concentrated radiation conditions, and expands the solar radiation concentration range without a need for special cooling. Combined with a higher GaP heat conductance compared to GaAs, this factor considerably improves the outlook for using this type of photoconductors in solar engineering units primarily intended for supplying power to remote and inaccessible regions where special solar cell cooling is either inefficient or impossible. References 3; figures 2.

Linear Concentrators With Uniform Energy Distribution on Flat Receiver

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[Article by A. V. Vartanyan, L. A. Gagiyan, Yerevan]

UDC 662.997:535.8

[Abstract] Linear concentrators creating a uniform energy distribution on a flat receiver and their modifications determined by the mutual spatial position of the reflecting surface and the receiver are considered. A linear concentrator with a continuous curvature generatrix for creating a uniform illumination of a plane receiver located at a random angle to the incident collimated radiation flux is described. Analytical relations and graphic relationships between the concentrator and receiver parameters are derived. The issue of taking into account the concentrator blockage by the receiver is addressed. Limiting values of the concentrator aperture angle are determined. It is shown that an analysis of the receiver irradiation patterns at various angles to the optical axis calls for further research. References 5; figures 3.

Heliostat's Automatic Sun Tracking System

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[Article by V. P. Nikolayev, N. G. Novoselova, T. T. Riskiyev, R. F. Rumi, L. V. Sementsov, Yu. I. Semushkin, L. V. Sokolov, V. L. Solunin, Engineering Physics Institute at the "Fizika-Solntse" Scientific Production Association of the Uzbek Academy of Sciences]

UDC 662.997:621.472

[Abstract] An automatic system for aiming the heliostat on the sun on the basis of the authors' algorithm which makes it possible to search for the sun and point the solar flux reflected by the heliostat's mirror in a given direction is described. The heliostat's automatic sun tracking

system is a part of a computer-aided multiheliostat field control system. Its principal elements include a wide-angle elevation data transducer with a $74 \times 4^\circ$ field and a fine elevation-azimuth axis transducer with a $4 \times 4^\circ$ field, threshold devices, amplifying relay elements with make and break contacts, an inverting element where the maximum output voltage is generated at a zero input signal, an amplifying relay element with make and two-way make-before-break contacts; a relay element generating a signal inhibiting the search algorithm repetition with a break contact, and power supply reference voltage sources with voltage dividers. Three versions of the automatic device operation are described. The above heliostat sun tracking system has been successfully tested as part of the control system for two regular "Solntse" complex heliostats whose pilot operation began in 1984. References 2; figures 1.

Today's Lighting Engineering and Electric Energy Economy

917K0175A Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 90 pp 6-9

[Article by V. S. Litvinov, A. Ye. Atayev]

UDC 621.311.1.004.18

[Abstract] Lighting engineering which deals with exploratory, applied, and production tasks related to generating, redistributing among illumination objects, and receiving optical radiation occupies a special place in modern science and engineering; lighting engineering consumes about 14 percent of the total generated electric power; this figure is expected to increase in the future. The negative and often significant effect of the poor quality of electric power, primarily the power supply voltage instability, on the power demand of today's lighting engineering devices and units is discussed. The development of energy efficient light sources (EIS) capable of reducing electric power consumption is described. EIS consume less power than conventional devices yet deliver the same luminous flux. A number of designs of incandescent EIS, including gas-filled and metal halogen lamps, and their specifications are listed. Electromagnetic starters-regulators used with gas discharge light sources and their characteristics are summarized. Specific measures aimed at increasing electric power savings are recommended. References 4.

Monoterm Insulation for Generator Stator Windings and Large Electric Motors

917K0175B Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 90 pp 12-14

[Article by T. A. Gureyeva, V. G. Ogonkov, S. G. Trubachev, V. V. Finkel, L. Z. Asnovich, All-Union Science Research Institute of Electric Insulation Materials]

UDC 621.315.611:621.313.04

[Abstract] Second-generation thermosetting plastic insulation (monoterm) which was developed in the late 70's for stator windings of turbine-driven and water-wheel generators is described. Monoterm insulation is characterized by better parameters than first-generation insulation; its sustained operating temperature is about 150°C vs. 130°C for first-generation insulation, the dependence of its dielectric loss tangent on voltage is insignificant, and its resistance to cyclical exposures, cyclical impact loads, and thermal and mechanical stress is higher. These properties are due to the use of a new thermosetting binder - a new polymer produced by catalytic polymerization of epoxidated soluble phenol formaldehyde resin. Subsequent monoterm insulation modification is summarized. Tests performed on monoterm samples are described and their results are cited. It is shown that the use of the new insulation makes it

possible to attain a considerable performance gain at heavy electric machinery plants due to significant decreases in the core production cycle and a total elimination of core and coil rejects due to the higher electro-physical properties of insulation as well as makes it possible to make generators and large electric motors with a high permissible operating temperature. The generators and large electric motors with the new insulation have a higher reliability and durability due to the monoterm's higher resistance to elevated temperatures, electric field, and mechanical loads. Figures 5; tables 2.

Improved Version of Monolit-2 Insulation

917K0175C Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 90 pp 15-17

[Article by V. V. Finkel, N. S. Oknin, V. G. Orlov, N. V. Kunitsina, All-Union Science Research Institute of Electric Insulation Materials]

UDC [621.315.616.97.]001.5

[Abstract] The monolit-2 insulation is used in heavy electric motors; it is made from the PK-11 impregnating epoxy compound on the basis of the ED-22 low-molecular diene resin and a mixture of methyltetrahydrophthalic anhydride isomers (IMTGFA). The experience of using this compound shows that one of its significant shortcomings is the limited service life. A modified compound was developed for solving this problem; it is modified by adding a low-viscosity active diluent which meets the requirements of being nontoxic, accessible, poorly volatile, and compatible with the compound. In addition to extending the compound service life, the use of the diluent made it possible to lower the impregnation temperature and improve certain electrical insulation parameters. A complex of ethyl ether fatty acids (KEEZHK) was used as the diluent. The effect of the amount of KEEZHK addition on monolit-2 insulation properties is examined and the results are cited and analyzed. The monolit-2 insulation was tested and test data are summarized. It is shown that the use of the modified compound makes it possible to stabilize the high-voltage electric motor stator impregnation process and considerably reduce the amount of epoxy compound waste. The economic impact of using the compound at two plants is 260 thousand rubles a year. References 3; figures 5; tables 1.

Stator Winding Insulation for Large Electric Motors

917K0175D Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 90 pp 17-20

[Article by N. S. Oknin, A. M. Kuznetsova, G. M. Podgorskaya, O. S. Bogoyavlenskiy, All-Union Science Research Institute of Electric Insulation Materials]

UDC 621.315.611:621.313.04

[Abstract] Today's monolit thermosetting plastic insulation widely used for making high-voltage electric motors of up to size 17 is economically inefficient in heavy-duty large electric motors due to the possibility of considerable losses if they need repairs as well as the inefficiency of using a large amount of scarce impregnated compound. The problem of developing an improved insulation system was addressed jointly by the All-Union Science Research Institute of Electric Insulation Materials (VNIIEIM), the Elektrosila Leningrad Production Association, and the Elektromash All-Union Science Research Institute. The new insulation meets the following requirements: it is made from insulation tape impregnated beforehand by injection molding; it is maintainable; its electric parameters are at least as good as those of the LSEP-9125TT band-based insulation; and the labor content of the stator winding with the new insulation system is lower than that of LSEP-9125TT band-based insulation winding. Two types of monolit-2 insulation system were selected as base insulation versions. High-voltage motor stator coils were made on the basis of the proposed insulation versions and subjected to comparative full-scale tests of electric and mechanical parameters. Test procedures and results are described. Test data show that insulation on the basis of LSEP-263T+LSG and LSM-LSG tape combinations has the best performance; these results are close to the long-term electric strength of the monolit insulation and exceed those of the LSEP-9125TT+LSEPL tape-based insulation. As a result, the LSEP-263T+LSG and LSM-LSG tape combination insulation was selected for subsequent development. References 3; figures 5; tables 3.

Low-Voltage Electrical Equipment Insulation for up to 300°C Operating Temperatures

917K0175E Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 90 pp 26-28

[Article by E. M. Dragunskiy, E. Z. Asnovich, All-Union Science Research Institute of Electric Insulation Materials]

UDC 621.315.611.001.5

[Abstract] The results of experiments to determine the real service life of electrical equipment made with organo-inorganic electric insulation systems (ONEI) are presented. Normally, ONEI-based electrical equipment is capable of operating at 250-300°C yet due to a lack of experimental data it has been impossible to ascertain its real service life. Ten samples of stator winding for open-slot electric motors with preformed winding were tested for each temperature. The design of the insulation system is summarized and test data are analyzed in detail. The "end point" criterion, i.e., insulation breakdown at the test voltage, was used to determine the insulation design service life but the criterion was not reached even after four years of testing. The "end point" criterion was then lowered to a 50 percent decrease in

insulation breakdown voltage but even in this case it was not reached after cyclical tests. As a result, the results of functional tests, i.e., the dependence of the aging time on the test temperature were used to determine the ONEI service life. The resulting data were extrapolated for the 20,000 h base service life; thus, the insulation system's thermal endurance was found to be equal to 265°C. It is noted that the proposed ONEI is quite redundant making it possible to use it at higher temperatures. References 1; figures 5; tables 1.

Glass Fiber and Mica Reinforced Tape for Thermal Endurance Class N Low-Voltage Electrical Equipment Insulation

917K0175F Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 90 pp 31-33

[Article by M. L. Pustynnik, Ye. V. Lokhmanova, S. B. Shagalov, L. S. Zbarskaya, M. N. Muzafarova, All-Union Science Research Institute of Electric Insulation Materials]

UDC 621.315.612.001.5

[Abstract] The results of a study of an organosilicon binder with higher thermal endurance and manufacturability and a glass fiber and mica paper tape developed for electrical equipment with a heat endurance of 180°C are cited. The effect of oxidant compositions which release atomic oxygen during decomposition on thermal destruction of polydimethylphenylsiloxane (PDMFS) and polydimethylphenylalumosiloxane (PDMFAC) is determined. It is found that given a 0.1-0.3 mass percent oxidant content relative to atomic oxygen, the thermal stability of the polyorganosiloxanes (POS) under study increases greatly. The effect of various modifying additives on the drying, setting, and gelatination time of the PDMFS (KO-922 lacquer) solution was examined. It is established that addition of polyalumophenylsiloxane (PAFS) and benzoyl peroxide (PB) to the KO-922 lacquer greatly decreases the lacquer film drying time. It is shown that the PDMFS solution modification by PAFS and PB greatly shortens the setting time and increases thermal stability. The LIKO-TT heat resistant glass fiber and mica reinforced plastic tape were developed on the basis of the modified organosilicon binder for low-voltage electrical equipment winding insulation with a permissible working temperature of 180°C; its commercial production began at the Elektroizolit production association. Insulation from the LIKO-TT tape has a service life of over 25,000 h, matches the performance of the LEK-TT tape, and is much cheaper. Figures 3; tables 3.

New Commutator Insulation Materials

917K0175G Moscow ELEKTROTEKHNIKA in Russian No 12, Dec 90 pp 33-35

[Article by V. V. Rozhkov, M. L. Pustynnik, A. I. Lebedev, O. T. Ivanilova, All-Union Science Research Institute of Electric Insulation Materials]

UDC 621.315.611.001.5

[Abstract] Operating reliability of DC current motors largely depends on the commutator reliability and insulation liner characteristics. Commutator micanites (KM) on the basis of crushed mica and shellac, glyptal, or polyester binders do not meet the stringent electrical engineering standards of longer service life, smaller labor content, and lower consumption of materials. It is shown that commutator mica and paper materials (KS) are largely free of KM shortcomings. Two KS brands with improved characteristics being commercially produced today are described: the KIFE commutator mica plastic and the KIFE-A reinforced mica plastic; the latter is designed for use in large generators and traction motors. It is reinforced with glass fibers impregnated with EP-9158 and ED-16 epoxy binder. The binders were tested to determine their operating temperature, viscosity, gelatination time, volatile component fraction, resistivity, dielectric strength, and temperature gravimetric index (TGI). Test results and performance characteristics of commutator materials as well as their electrical characteristics are summarized. It is shown that KIFE and KIFE-A characteristics correspond to world standards and their manufacturing technology is distinguished by considerably lower material and labor outlays than those of KM. It is expected that in 1990 the new KS production volume will reach 500 tons with an attendant decrease in the production of KM. References 2; tables 3.

Examination of Superhigh-Molecular Polyethylene for Cryogenic Cable Insulation

917K0175H Moscow ELEKTROTEKHNIKA
in Russian No 12, Dec 90 pp 66-69

[Article by Wu Wei-Han, Hao Feng-Nian, Qinghua University, Beijing]

UDC [621.315.611::678.742.2].001.5

[Abstract] The development of superhigh-molecular polyethylene (SVM-PE) for use as insulation for cryogenic cables is summarized. SVM-PE was examined at the Qinghua University to determine the mechanical properties of SVM-PE film at liquid nitrogen temperatures and mechanical properties of extrusion molded polymer insulation for cryogenic cable as well as to

measure the strain distribution in the SVM-PE insulation layer by the moire method and establish the electric insulation properties of SVM-PE at cryogenic temperatures. Test procedures and results are described. Research data show that SVM-PE has good mechanical and electric insulation properties at cryogenic temperatures thus making it realistically possible to use it as insulation for cryogenic cable or other cryogenic devices. References 7; 3 Russian, 4 Western; figures 5; tables 3.

New Approach to Thermobaric Insulation Tests

917K0175I Moscow ELEKTROTEKHNIKA in Russian
No 12, Dec 90 pp 69-72

[Article by Ya. Z. Mesenzhnik, All-Union Scientific Technological Research, Design, and Development Institute of Cable Industry]

UDC 621.317.333.6.001.4

[Abstract] The development of simplified nondestructive methods of testing insulation under thermal and baric loading which are physically equivalent to destructive on-site tests and efficient is summarized. It is shown that such methods can be developed by combining two trends: finding a correlation between various characteristics of insulation under thermal and baric loading and physical and mathematical equivalents of thermal (realized with the help of simple devices) and thermobaric insulation tests. Tests of electric and thermal conductivity of various materials and electric insulation designs were performed on the basis of a two-factor variance analysis making it possible to establish the percent contribution of each factor (T and P) severally and jointly. It is shown that in order to obtain the necessary insulation characteristics under a thermobaric loading, one has to determine these characteristics at a certain equivalent temperature. The proposed approach also makes it possible to derive differential and integral expressions for determining the values of primary and secondary transmission parameters of lines submerged in wells at a random point. B. M. Tareyev and L. Ya. Prut participated in research. References 13; figures 1; tables 3.

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